U.S. Army Public Health Command
(Provisional)

USAPHC

INJURY PREVENTION REPORT NO. 12-HF-0C7F-10
U.S. ARMY DEPLOYMENT INJURY
SURVEILLANCE SUMMARY
CALENDAR YEAR 2008
1 JANUARY 2008–31 DECEMBER 2008

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14. ABSTRACT
The U.S. Army Public Health Command (Provisional) maintains an injury surveillance system for deployed Soldiers. U.S. Transportation Command's Regulating and Command & Control Evacuation System (TRAC^{2}ES) data for Soldiers medically air evacuated from U.S. Central Command while deployed for Operation Iraqi Freedom (OIF; March 2003-December 2008) and Operation Enduring Freedom (OEF; October 2001-December 2008) was coded for cause of injury. Additional sources of injury data were the Standard Inpatient Data Records and Defense Casualty Information Processing System data. Descriptive statistics were used to show nonbattle injury (NBI) rates over time, the frequencies of NBIs and fatalities, all injuries compared to disease diagnosis groups, and causes of NBIs. Injury matrices were used to describe the frequency of NBIs by body region and nature of injury. For OIF, NBI rates decreased over time from a high in 2003. The OEF NBI rates have fluctuated over time. For OIF and OEF combined, injuries air-evacuated out-of-CENTCOM (battle and nonbattle combined) comprised 50% of all battle/nonbattle/disease incidents. Leading causes of NBIs were sports/physical training, falls/jumps, toxic substances, land transport accidents, and crush/blunt trauma. Recommendations are to continue surveillance of deployment injuries and identify modifiable risk factors that contribute to the leading causes of injury to inform injury prevention practice and policy.

15. SUBJECT TERMS
Army, injuries, NBIs, surveillance, OIF, and OEF

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EXECUTIVE SUMMARY
INJURY PREVENTION REPORT NO. 12-HF-0C7F-10
U.S. ARMY DEPLOYMENT INJURY SURVEILLANCE SUMMARY 2008
1 JANUARY 2008–31 DECEMBER 2008

1. PURPOSE. The aims of this report are to—

a. With respect to Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) deployed Soldiers—

(1) Describe the relative impact of injury compared to disease for calendar year (CY) 2008.

(2) Provide nonbattle injury (NBI) rates and trends from 2003–2008.

(3) Identify leading diagnoses and causes of NBI for CY 2008.

b. Draw conclusions and make recommendations to advance Army injury prevention.

c. Provide summaries of key U.S. Army Public Health Command (Provisional) (USAPHC (Prov)) CY 2008 analytic deployment surveillance projects on injuries among deployed Soldiers.

2. CONCLUSIONS.

a. Army OIF/OEF Deployment Injury Surveillance Summary 2008. Routinely collected air evacuation, inpatient hospitalization, and casualty data provide the basis for deployment injury surveillance during current Army deployments in support of OIF and OEF. The NBIs are notably the most significant cause of medical evacuations. The NBI was second to digestive diseases for OIF hospitalizations and second to battle injuries for OEF hospitalizations. Approximately two-thirds of battle fatalities were due to explosives. The leading causes of NBIs (that is, sports, falls and jumps, toxic substances, land transport accidents) indicate that they are likely preventable. Timely reporting of injury rates, types and causes should allow Commanders and Army leaders to focus attention on prevention strategies and policies while the operations are ongoing.

b. Results of Analytic Deployment Injury Surveillance Projects, CY 2008. The relative importance of NBI fatalities, hospitalizations, and air evacuations among deployed OEF/OIF Soldiers has been clearly established. These injuries negatively impact job performance and possibly Soldier retention. Soldiers with pre-deployment chronic and recurrent injuries and musculoskeletal conditions and Soldiers within specific military occupational specialties (MOSs) are potential populations for further investigation into frequency of injury, type of injury, cause of injury, and injury outcome.

3. RECOMMENDATIONS.

a. Continue timely surveillance of deployment injury.

b. Link additional data sources to provide an enhanced description of deployment injury.

c. Conduct further research to identify modifiable risk factors that contribute to the leading causes of injury.

d. Devote additional study to falls/jumps, sports/physical training, own weapon, toxic substances, and land transport injury prevention.

e. Investigate the use and effectiveness of injury prevention strategies/interventions (such as, vehicle exiting, seatbelt use, suicide prevention).

f. Explore the relationship of mental healthcare utilization and self-inflicted injury.

g. Continue to develop policy and practice to prevent deployment-related injuries.

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U.S. ARMY OIF/OEF DEPLOYMENT INJURY SURVEILLANCE SUMMARY
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1. REFERENCES. References are listed in Appendix A.

2. PURPOSE. The aims of this report are to—

a. With respect to Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) deployed Soldiers:

(1) Describe the relative impact of injury compared to disease for Calendar Year (CY) 2008.

(2) Provide nonbattle injury (NBI) rates and trends from 2003–2008.

(3) Identify leading diagnoses and causes of NBI for CY 2008.

b. Draw conclusions and make recommendations to advance Army injury prevention.

c. Provide summaries of key U.S Army Public Health Command (Provisional) (USAPHC (Prov)) CY 2008 analytic deployment surveillance projects on injuries among deployed Soldiers.

3. AUTHORITY. Under Army Regulation (AR) 40-5, Section 2-19, the U.S. Army Public Health Command (Provisional) (USAPHC (Prov), formerly known as the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), is responsible for providing support for Army preventive medicine activities, to include review and interpretation of surveillance data and identification and characterization of health problems as a foundation for injury prevention planning efforts.

4. ARMY OPERATION IRAQI FREEDOM AND OPERATION ENDURING FREEDOM DEPLOYMENT INJURY SURVEILLANCE SUMMARY 2008.

a. Background. Injuries are the biggest health problem confronting U.S. military forces in garrison and combat operations.[1] For present operations OIF and OEF, NBIs were more frequently reported in medical air evacuation and hospitalization data than battle injuries or any other individual disease diagnosis group.[2-5] This report uses injury data that has been coded from incident narratives for cause of injury to describe

battle injury (BI) and NBI distribution, counts, and causes. Injury rates are also an important part of surveillance data analysis and may vary by type of outcome (such as, hospitalization, air evacuation, death). Determining the factors that are related to these differences in rates is as important as knowing the rates themselves. Tracking the trends for injury and disease over time highlights areas in need of intervention due to the magnitude of the problem, undesirable changes over time, or undesirable differences between locations and operations. The study of injury diagnoses, which encompasses the nature of the injury and body region, is of interest due to the significance of the injuries to longer term Soldier health and operational readiness.

b. Methods.

(1) Injury Data Sources.

(a) Injury data for air evacuated Soldiers were obtained from the U.S. Transportation Command's Regulating and Command & Control Evacuation System (TRAC^{2}ES). These data are routinely collected and used to request and coordinate medical air evacuation of Service members with serious injuries and diseases.

(b) Fatality data were obtained from the Defense Casualty Information Processing System (DCIPS). These data are routinely collected and used for casualty tracking and mortuary affairs. Fatality data for cause of battle injury death were obtained from the Defense Manpower Data Center (DMDC).

(c) Standard Inpatient Data Records (SIDR) for hospitalizations in the U.S. Central Command (CENTCOM) area of responsibility were obtained from the Patient Administration Systems and Biostatistics Activity (PASBA), a component of the Decision Support Center, Office of the Surgeon General. These electronic records were created from medical records that were forwarded to PASBA after Soldiers were hospitalized during deployments. These SIDR records are the official electronic record of a hospitalization in a Department of Defense (DOD) medical facility.

(d) Injury data for yearly rate calculations were obtained for the same population from the same sources for the 2003–2008 CYs.

(2) Relative Importance of Injury and Disease Information.

(a) Primary Diagnosis Groups from the International Classification of Diseases, 9th Revision, Clinical Module (ICD-9-CM) and BI/NBI/Disease indicators were used to create the relative importance of injury and disease figures using out-of-CENTCOM medical air evacuation and in-CENTCOM hospitalization data. All injuries are based on out-of-CENTCOM air-evacuation patient movement or initial inpatient hospitalization

record. When summarizing air evacuations, the number of Soldiers who required air evacuation is reported, rather than the number of air-evacuation movements for those Soldiers.

(b) A “30–day” hospitalization exclusion was used so that injury hospitalizations for the same diagnosis (3-digit ICD-9-CM code) within a 30–day timeframe of the initial event were not included in the analysis. This 30-day timeframe has proven to account for distinct injuries considering that some injuries required multiple hospitalizations.

(c) A “60–day” air-evacuation exclusion was used so that injury medical air evacuations for the same diagnosis within a 60–day timeframe of the initial event were not included in the analysis. Air evacuation does not use the same “30-day” rule as hospitalizations because a single injury could result in numerous air-evacuation movements between CENTCOM and continental United States (CONUS) and subsequent (greater than 30 days) movements from CONUS military treatment facility (MTF) to CONUS MTF.

(3) NBIs.

(a) All OIF/OEF deployed U.S. Army Soldiers, who met at least one of the following criteria for CY 2008, were included in the NBI category and analyses: (1) death from an NBI that occurred within the CENTCOM theater, (2) an NBI that required hospitalization in-CENTCOM, or (3) an NBI that required air evacuation out-of-CENTCOM.

(b) The NBIs that required air evacuation only within CENTCOM were excluded from these analyses.

(4) Injury Rate Calculations. The NBI rates calculated in this report were based on all NBIs as defined above. Data for person-years (PY) of deployment were obtained from the Armed Forces Health Surveillance Center (AFHSC).[6]

(5) Causes of NBI.

(a) Causes of NBIs were identified from narrative patient histories in the air evacuation and fatal casualty records. Trained coders used the coding scheme from the North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) No. 2050, 5th Edition (Military Agency for Standardization, 1989) to categorize the cause of injury.[7] The STANAG coded causes of injury were already present in the in CENTCOM hospitalization records (SIDR) from PASBA. The STANAG codes are four-digit codes describing the intent/situation of the injury incident, injury cause, and where the injury occurred. The first digit is the trauma code indicating the type of injury that

occurred (that is, battle, intentional nonbattle, or unintentional nonbattle). The second through fourth digits indicate the cause of injury, identifying the specific causative agent and in some cases where the injury occurred.

(b) Causes of NBI during CY 2008 were summarized for the in-CENTCOM fatalities, in CENTCOM hospitalizations, and out-of CENTCOM air evacuations.

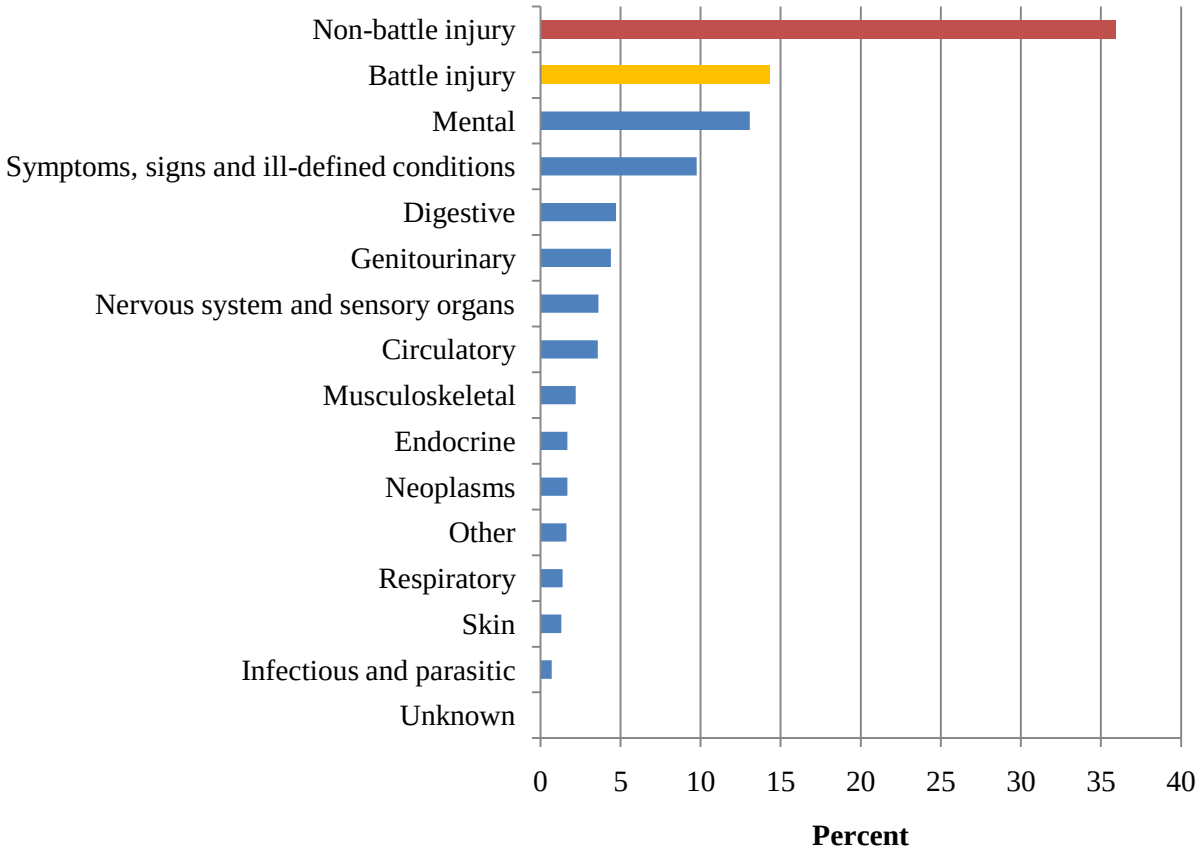
(6) Nature of Injury by Body Region Matrices for NBIs.

(a) The Barell[8] injury matrix was used to display injury frequencies for traumatic NBIs (ICD-9-CM codes 800-995; see Appendix B) in a standardized format with the nature of the injury listed horizontally, across the top of the table, and body region listed vertically along the left side of the table. Two Barell matrices are shown; one that included only NBIs that required air evacuation out-of-CENTCOM and another that included only NBIs that required in-theater hospitalization.

(b) A similar matrix format was used to display frequencies for injury-related musculoskeletal conditions (subset of ICD-9-CM codes 719-739; see Appendix C). Two musculoskeletal matrices are shown; one that included only NBIs that required air evacuation out-of-CENTCOM and another that included only NBIs that required in-theater hospitalization.

(c) For the matrices, NBIs were categorized into two groups by injury type (acute traumatic and injury-related musculoskeletal conditions). The remainder of the NBIs (that is, those that did not fit into these two categories) could not be classified into meaningful subgroups and were not included.

c. Results.



Note: Includes injury and disease resulting in out-of-CENTCOM air evacuation for 5,886 Soldiers.

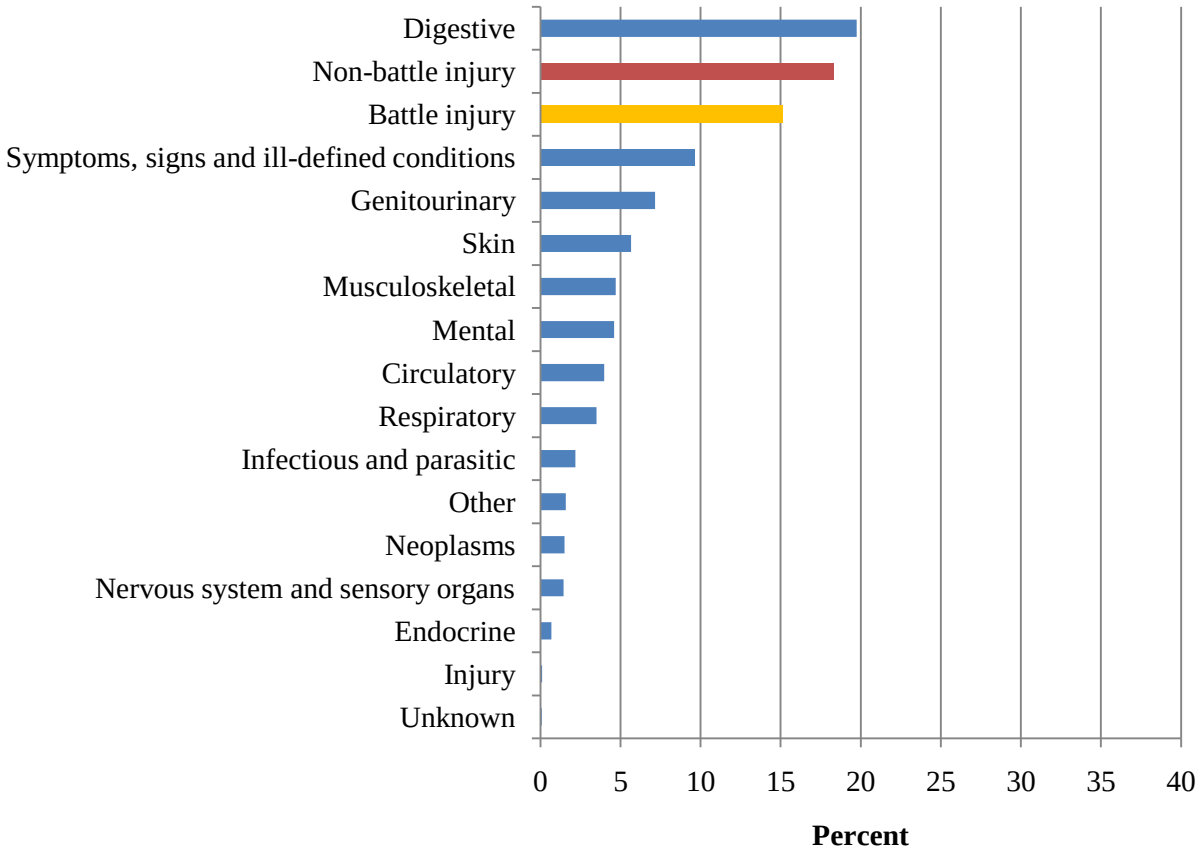
Figure 1. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Air-Evacuated U.S. Army Soldiers, OIF/OEF, CY 2008

Figure 1. Note:

- Figure 1 shows the percentage of injuries (battle and nonbattle) and disease by primary diagnosis groups (ICD-9-CM code) for all out-of-CENTCOM medical air evacuations CY 2008.

- In 2008, 5,886 Soldiers were medically air evacuated out-of-CENTCOM.

- The NBIs accounted for 36 percent (n=2,115) of these air evacuations, nearly three times as many as the leading disease diagnosis group, “mental” (n=770, 13 percent).



Note: Includes injury and disease resulting in in-CENTCOM hospitalization (N=3,802).

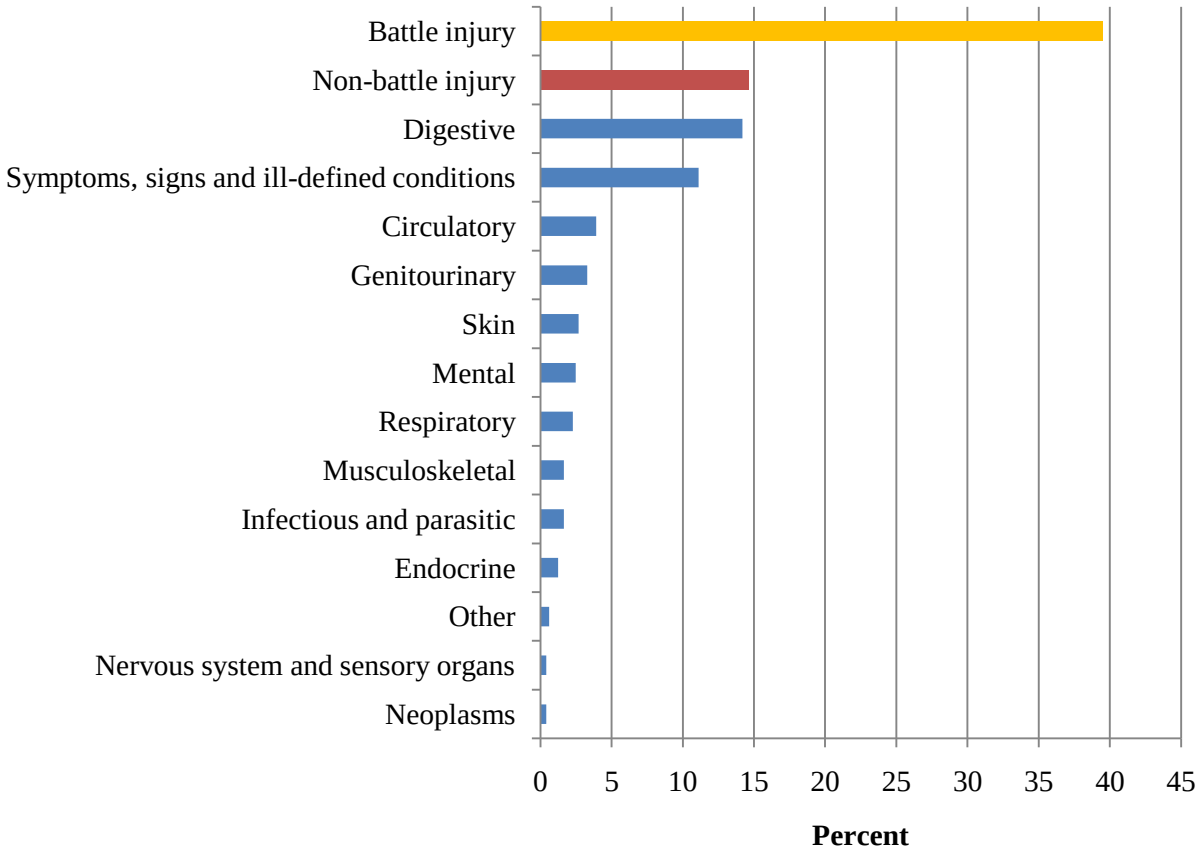
Figure 2. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Hospitalized U.S. Army Soldiers, OIF, CY 2008

Figure 2. Notes:

- Figure 2 shows the percentage of injuries (battle and nonbattle) and disease by primary diagnosis groups (ICD-9-CM code) for OIF in-CENTCOM hospitalizations CY 2008.

- In 2008, 3,802 OIF Soldiers were hospitalized in-CENTCOM.

- The leading disease diagnosis group was “digestive” (n=751, 19.8 percent). However, injuries (BI and NBIs combined) accounted for a somewhat greater proportion (n=1,271; 33.4 percent) of these hospitalizations.



Note: Includes injury and disease resulting in in-CENTCOM hospitalization (N=486).

Figure 3. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Hospitalized U.S. Army Soldiers, OEF, CY 2008

Figure 3. Notes:

- Figure 3 shows the percentage of injuries (battle and nonbattle) and disease by primary diagnosis groups (ICD-9-CM code) for OEF in-CENTCOM hospitalizations CY 2008.

- In 2008, there were 486 OEF in-CENTCOM hospitalizations.

- The BI and NBIs combined accounted for 54.1 percent (n=263) of these hospitalizations.

- OEF had a significantly greater proportion of BI hospitalizations ($p<.001$) than OIF. OIF had a significantly greater proportion of digestive and genitourinary disease hospitalizations than OEF (both $p<.001$). The proportion of NBIs did not differ.

Table 1. Injury and Disease[1] among U.S. Army Soldiers Deployed for OIF, CY 2008

	BI		NBI[2]		Disease	
	Count (n)	Row Percent (%)	Count (n)	Row Percent (%)	Count (n)	Row Percent (%)
Deaths[3] (n=266)	188	71	69	26	7	3
Air Evacuations (n=4772)	596	13	1679	35	2497	52
Hospitalizations (n=3802)	575	15	696	18	2531	67

Notes:
[1] Death, air evacuation, and hospitalization categories are not mutually exclusive.
[2] Includes acute injury and injury-related musculoskeletal conditions.
[3] Death count was obtained from DCIPS data.

Table 1. Notes:

- Table 1 provides a summary of OIF deployment NBI casualties for 2008.

- For every 1 deployment NBI death, there were 10 NBI hospitalizations and 24 NBI medical air evacuations.

- Conservatively assuming no overlap among air evacuations, hospitalizations, and deaths, at least 44 percent of BIs resulted in out-of-CENTCOM air evacuation, 42 percent in in-theater hospitalization, and 14 percent in death.

- Injury fatalities have been a major focus of injury prevention resources in the past. However, as shown by these data, there are far more nonfatal injuries that result in medical-air evacuation or hospitalization than fatal injuries. These nonfatal outcomes result in significant lost-duty time and decreased operational readiness for the Army.

Table 2. Injury and Disease[1] among U.S. Army Soldiers Deployed for OEF, CY 2008

	BI		NBI[2]		Disease	
	Count (n)	Row Percent (%)	Count (n)	Row Percent (%)	Count (n)	Row Percent (%)
Deaths[3] (n=115)	98	84	17	15	1	1
Air Evacuations (n=1114)	248	22	334	30	532	48
Hospitalizations (n=486)	192	40	71	15	223	46

Notes:
[1] Death, air evacuation, and hospitalization categories are not mutually exclusive.
[2] Includes acute injury and injury-related musculoskeletal conditions.
[3] Death count was obtained from Defense Casualty Information Processing System (DCIPS) data.

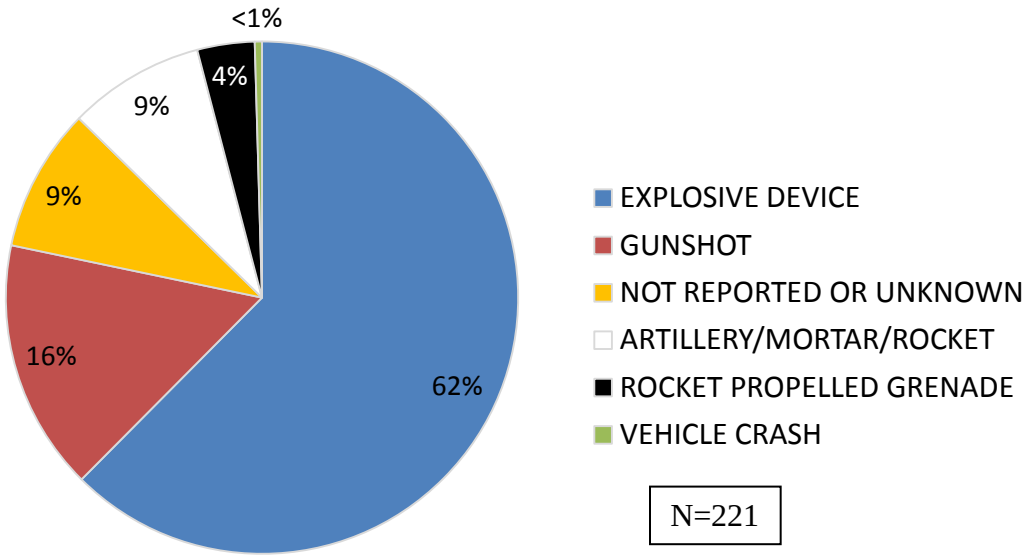
Tables 2. Notes:

- Table 2 provides a summary of OEF deployment NBI casualties for 2008.

- For every 1 deployment NBI death, there were 4 NBI hospitalizations and 20 NBI medical air evacuations.

- Conservatively assuming no overlap among air evacuations, hospitalizations, and deaths, at least 46 percent of BIs resulted in out-of-CENTCOM air evacuation, 36 percent in in-theater hospitalization, and 18 percent in death.

- Again, these data show there are far more nonfatal injuries that result in medical-air evacuation or hospitalization than fatal injuries. These nonfatal outcomes result in significant lost-duty time and decreased operational readiness for the Army.

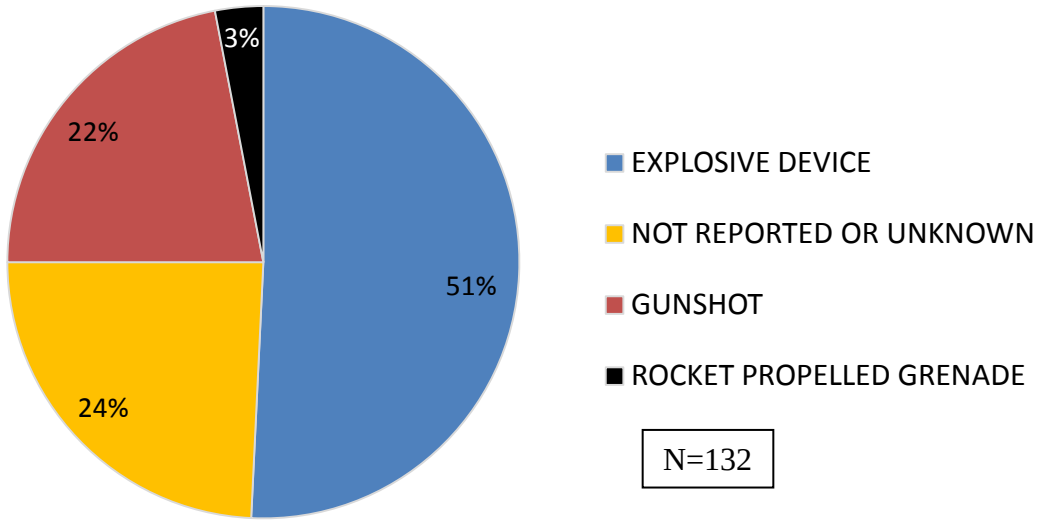


Notes:
[1] Data obtained from Defense Manpower Data Center (DMDC).[(9)]

Figure 4. Distribution (%) of Battle Injury Death Causes[1] among U.S. Army Soldiers Deployed for OIF, CY 2008

Figure 4. Notes:

- Figure 4 illustrates causes of OIF Army battle injury deaths for CY 2008.
- 62 percent of battle fatalities were due to explosive devices.
- 16 percent of battle fatalities were due to gunshots.
- 9 percent of battle fatalities were due to artillery, mortar, or rockets.

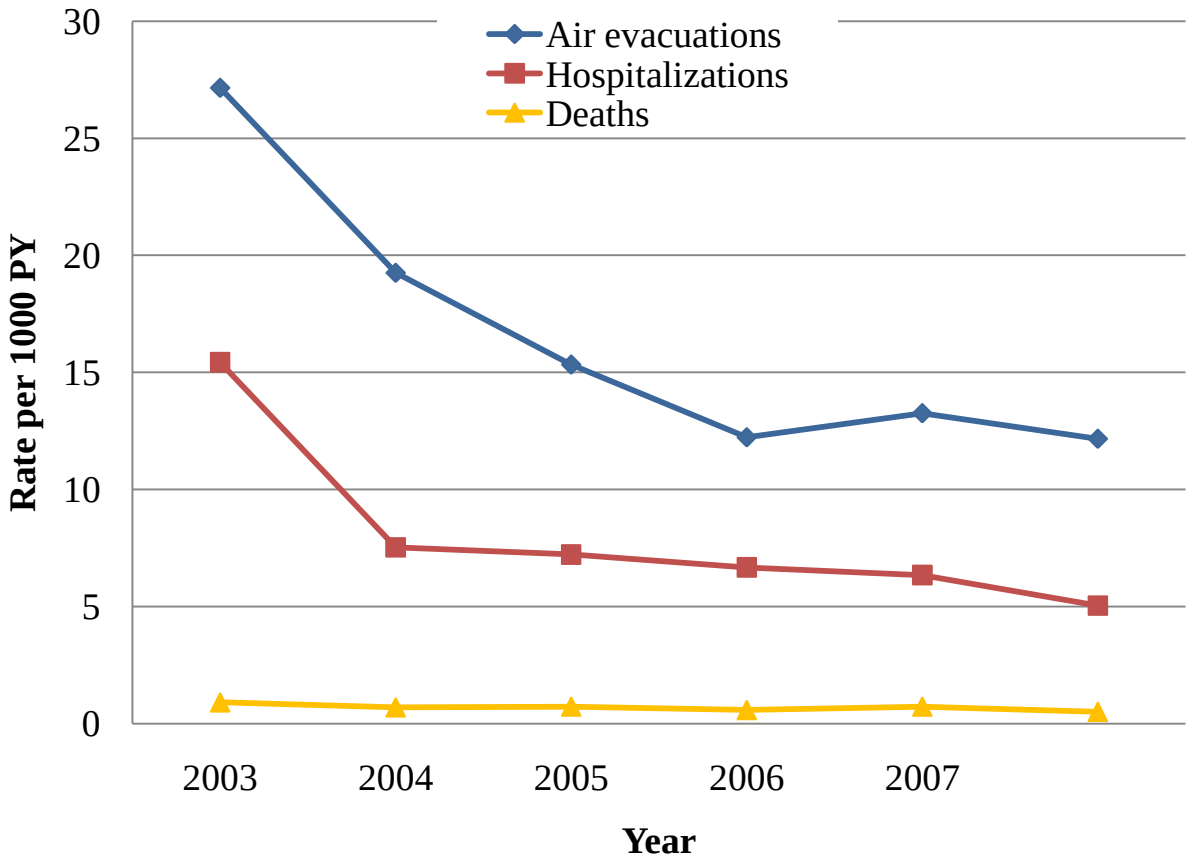


Notes:
[1] Data obtained from Defense Manpower Data Center (DMDC).

Figure 5. Distribution (%) of Battle Injury Death Causes[1] among U.S. Army Soldiers Deployed for OEF, CY 2008

Figure 5. Notes:

- Figure 5 illustrates causes of OEF Army battle injury deaths for CY 2008.
- 51 percent of battle fatalities were due to explosive devices.
- 24 percent of battle fatalities were due to gunshots.
- Unlike OIF, unless represented within “Not Reported or Unknown”, no battle fatalities for OEF were due to artillery, mortar, or rockets.

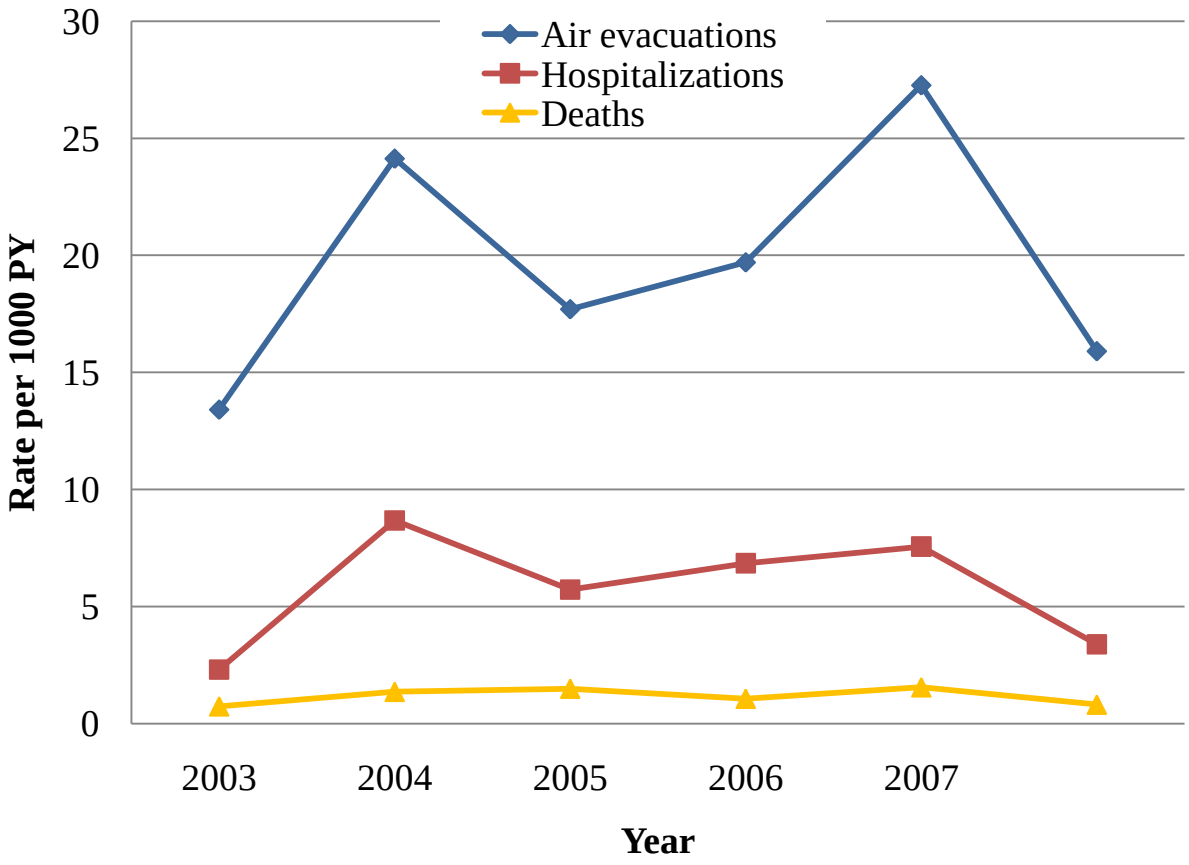


Notes:
[1] Denominators for the rates were obtained from the Armed Forces Health Surveillance Center.

Figure 6. NBI Rates among U.S. Army Soldiers Deployed for OIF, CYs 2003-2008[1]

Figure 6. Notes:

- Figure 6 illustrates OIF NBI rates from 2003–2008.
- The OIF NBI air evacuation and hospitalization rates have decreased over time.
- The OIF NBI death rates have remained constant over the period, consistently less than 1 death per 1,000 person-years.



Notes:
[1] Denominators for the rates were obtained from the Armed Forces Health Surveillance Center.

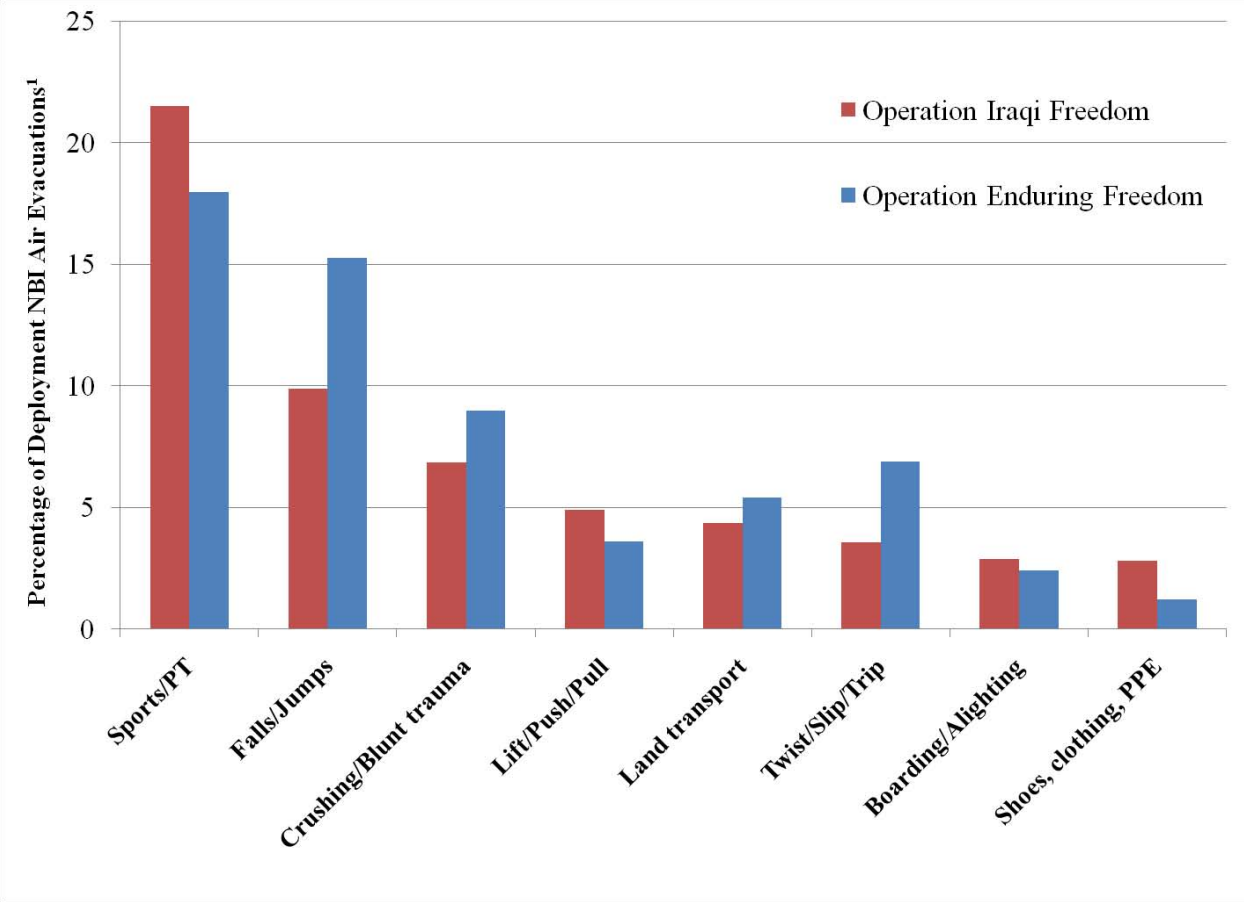
Figure 7. NBI Rates among U.S. Army Soldiers Deployed for OEF, CYs 2003-2008[1]

Figure 7. Notes:

- Figure 7 illustrates OEF NBI rates from 2003–2008.

- The OEF NBI air evacuation and hospitalization rates tended to increase slightly between 2003 and 2007, but decreased from 2007 to 2008.

- The OEF NBI death rates have remained constant over the period, consistently less than 2 deaths per 1,000 person-years.



Note: Percentages are of the portion of 2008 deployment NBI air evacuations for each operation (OIF: N=1,679; OEF: N=334).

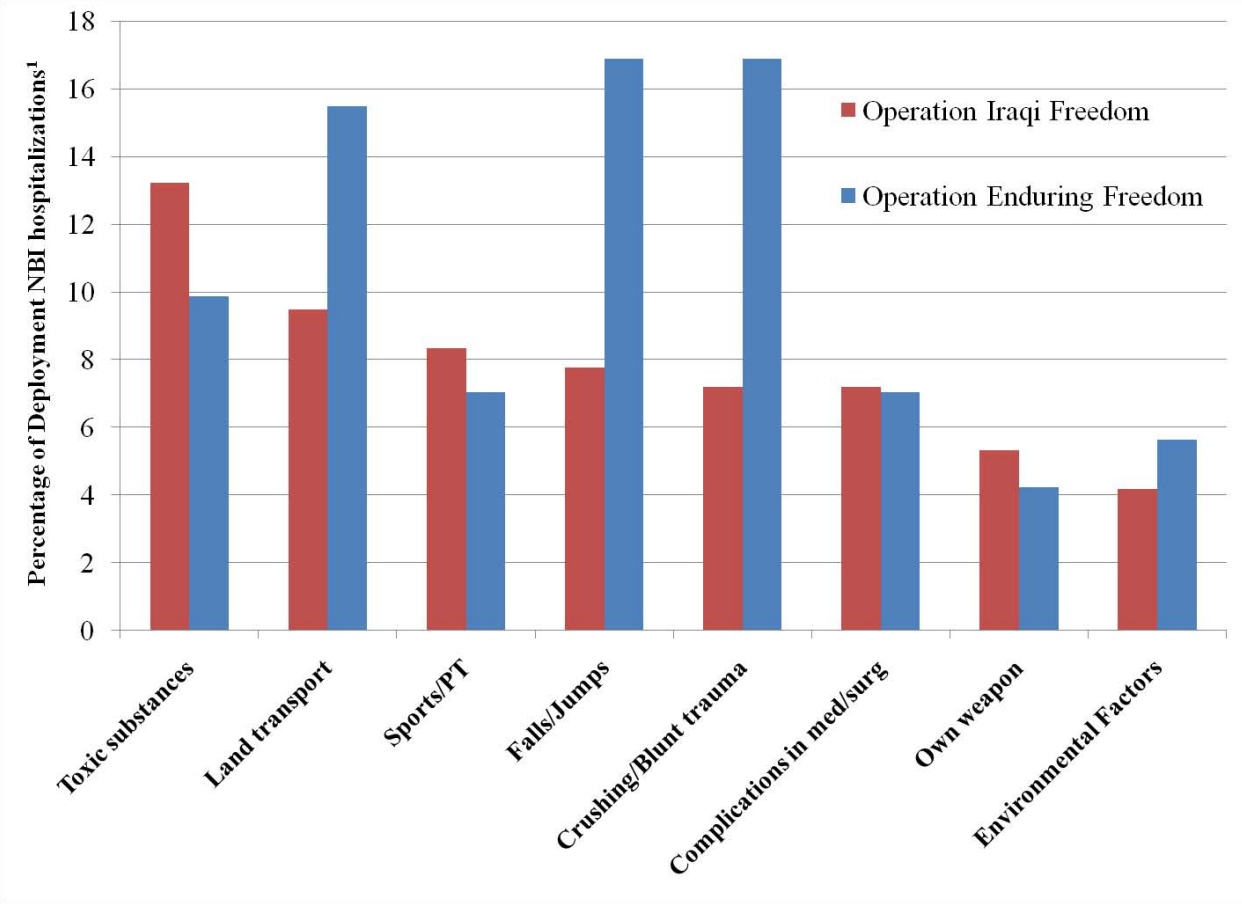
Figure 8. Distribution of Leading Causes of NBI Air Evacuations among U.S. Army Soldiers Deployed for OIF/OEF, CY 2008

Figure 8. Notes:

- Figure 8 illustrates the distribution of the leading NBI causes for air evacuation by STANAG 2050 injury causes code groups.

- In 2008, cause of injury was identified for 1,450 of the NBIs (72 percent).

- 21 percent of NBIs were due to sports and physical training (PT). The leading causes of sports-related NBIs were: basketball (24 percent), weightlifting (19 percent), PT (18 percent), and football (14 percent).



Note: Percentages are of the portion of 2008 deployment NBI hospitalizations for each operation (OIF: N=696; OEF: N=71).

Figure 9. Distribution of Leading Causes of NBI Hospitalizations among U.S. Army Soldiers Deployed for OIF/OEF, CY 2008

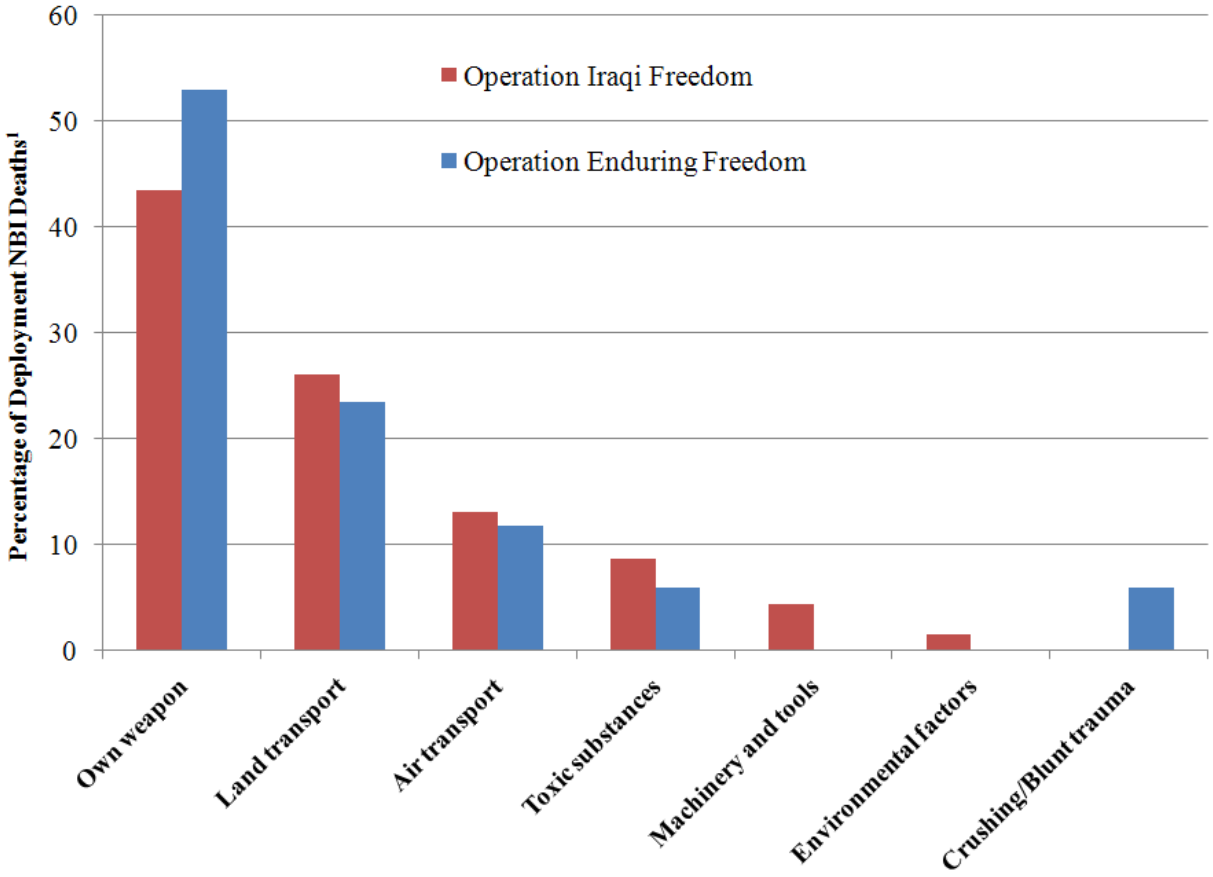
Figure 9. Notes:

- Figure 9 illustrates the distribution of the leading NBI causes for hospitalization by STANAG 2050 injury causes code groups[(7)].

- 52 percent of toxic substance cases (poisonings) were intentionally self-inflicted.

- 10 percent of “own weapon” hospitalizations were intentionally self-inflicted.

- The leading causes of hospitalization that differed between OIF and OEF were Falls/Jumps ($p<.01$) and Crush/Blunt Trauma ($p<.01$).



Notes:
[1] Deaths for cause of injury coding were obtained from DCIPS.
[2] Percentages are of the portion of 2008 deployment NBI deaths for each operation (OIF: N=69; OEF: N=17).

Figure 10. Distribution of Causes of NBI Deaths among U.S. Army Soldiers Deployed for OIF/OEF, CY 2008

Figure 10. Notes:

- Figure 10 illustrates the distribution of the leading NBI death causes by STANAG 2050 injury causes code groups.

- 87 percent of "own weapon" were intentionally self-inflicted (N=32) or intentionally inflicted by another (N=2).

- The second leading cause of NBI fatalities was accidents involving land transport vehicles (26 percent).

Table 3. Frequency of Traumatic Air Evacuated NBIs by Location and Nature of Injury, U.S. Army, OIF/OEF, CY 2008

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/Superficial	Crush	Burns	Nerves	Unspecified	System-wide & late effects	Total	Percent	Percent by Body Region
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI				9										9	0.8	4.0
		Type 2 TBI	3			33										36	3.2	
		Type 3 TBI														0	0.0	
	Other Head, Face, Neck	Other head					2						1	5		8	0.7	3.2
		Face	16													16	1.4	
		Eye								3		1	1			5	0.4	
		Neck					1						2			3	0.3	
		Head, Face, Neck Unspec.							1	1		2				4	0.4	
Spine and Back	Spinal Cord (SCI)	Cervical SCI				2										2	0.2	0.5
		Thoracic/Dorsal SCI	1													1	0.1	
		Lumbar SCI														0	0.0	
		Sacrum Coccyx SCI				1										1	0.1	
		Spine, Back Unspec. SCI				2										2	0.2	
	Vertebral Column (VCI)	Cervical VCI	3	1	4											8	0.7	1.9
		Thoracic/Dorsal VCI	2		1											3	0.3	
		Lumbar VCI	1		4											5	0.4	
		Sacrum Coccyx VCI			1											1	0.1	
		Spine, Back Unspec. VC	5													5	0.4	
Torso	Torso	Chest (thorax)				3	2									5	0.4	2.0
		Abdomen				2	1		1				1			5	0.4	
		Pelvis, Urogenital	5				1						1			7	0.6	
		Trunk												1		1	0.1	
		Back, Buttock			3					1	1					5	0.4	
Extremities	Upper	Shoulder, Upper Arm	28	66	54		3			5				13		169	14.9	43.4
		Forearm, Elbow	54	1	6		3					2				75	6.6	
		Wrist, Hand, Fingers	119	6	12		23	14		3	8	6		17		208	18.3	
		Other & Unspec.	5									1	36			42	3.7	
	Lower	Hip	6		3											9	0.8	37.7
		Upper leg, Thigh	6													6	0.5	
		Knee	8	124	27					1						160	14.1	
		Lower leg, Ankle	121	5	2					1						147	12.9	
		Foot, toes	4	3	4		2	1		2	2					54	4.7	
		Other & Unspec.	2		32		11					2		6		53	4.7	
Unclass. by Site	Other, Unspecified	Other/Multiple											3			3	0.3	4.0
		Unspec. Site	22	1	9					2		7		1		42	3.7	
	System-wide & late effects														38	38	3.3	
		Total	447	216	180	52	49	15	2	19	11	21	45	43	38	1138		
		Percent	39.3	19.0	15.8	4.6	4.3	1.3	0.2	1.7	1.0	1.8	4.0	3.8	3.3		100.0	100.0

Note:
ICD-9-CM 800-995 CODES. Includes only injuries resulting in out-of-CENTCOM air evacuation.

Table 3. Notes:

- Table 3 uses the Barell[8] injury matrix to categorize traumatic NBIs that required medical air evacuation by nature of injury and body region.

- In 2008, there were 1,138 NBIs that required medical air evacuation (coded in the 800-995 ICD-9-CM code series).

- The most common types of injury leading to medical air evacuation were fractures (39 percent), dislocations (19 percent), and sprains/strains (6 percent).

- Injured body regions most commonly leading to medical air evacuation were upper extremities (43 percent); lower extremities (38 percent); and head, face, and neck injuries (7 percent).

- Leading specific reasons for medical air evacuation included dislocation of the knee (11 percent), fractures of the lower leg and/or ankle (11 percent), fracture of the wrist, hand, and/or fingers (10 percent).

Table 4. Frequency of Air-Evacuated NBI-Related Musculoskeletal Conditions by Location and Nature of Injury, U.S. Army, OIF/OEF, CY 2008

			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	Percent	Percent by Body Region
Spine and Back	Vertebral Column (VCI)	Cervical VCI	28	11	13	0	0	0	52	8.6	50.6
		Thoracic/Dorsal VCI	0	1	18	0	0	0	19	3.1	
		Lumbar VCI	128	23	8	0	0	0	159	26.3	
		Sacrum Coccyx VCI	1	0	0	0	0	0	1	0.2	
		Spine, Back Unspec. VCI	49	15	11	0	0	0	75	12.4	
Extremities	Upper	Shoulder	41	7	0	0	17	5	70	11.6	14.4
		Upper Arm, Elbow	4	1	0	0	0	0	5	0.8	
		Forearm, Wrist	6	0	0	0	0	0	6	1.0	
		Hand	2	0	0	0	4	0	6	1.0	
	Lower	Pelvis, Hip, Thigh	10	1	0	0	1	0	12	2.0	25.8
		Lower leg, Knee	29	32	0	5	46	0	112	18.5	
		Ankle, Foot	27	5	0	0	0	0	32	5.3	
Unclass. by Site	Other, Unspecified	Other specified/Multiple	0	1	0	2	0	0	3	0.5	9.3
		Unspec. Site	14	1	22	3	12	1	53	8.8	
		Total	339	98	72	10	80	6	605		
		Percent	56.0	16.2	11.9	1.7	13.2	1.0		100.0	100.0

Note:
ICD-9-CM 710-739 CODES. Includes only injuries resulting in out-of-CENTCOM air evacuation.

Table 4. Notes:

- Table 4 categorizes NBI-related musculoskeletal conditions (a subset of musculoskeletal conditions coded in the 719-739 ICD-9-CM series) that required medical air evacuation by nature of injury and body region affected.

- In 2008, 831 NBI-related musculoskeletal conditions required medical air evacuation.

Table 4. Notes (continued):

- The most common types of musculoskeletal conditions leading to medical air evacuation were inflammation and pain (overuse) (56 percent), joint derangement (16 percent), and strains/sprains/rupture (13 percent).

- The spine/back (51 percent) was the body region most affected by injury-related musculoskeletal conditions, followed by lower extremities (26 percent), and upper extremities (14 percent).

- The leading specific injury-related musculoskeletal conditions were inflammation and pain (overuse) involving the lumbar spine (21 percent), inflammation and pain (overuse) involving the spine, unspecified location (8 percent), and strains/sprains/rupture to the lower leg and/or knee (8 percent).

Table 5. Frequency of Hospitalized NBIs by Location and Nature of Injury, U.S. Army, OIF/OEF, CY 2008

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/Superficial	Crush	Burns	Nerves	Unspecified	System-wide & late effects	Total	Percent	Percent by Body Region
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	8			10							0			18	1.8	7.5
		Type 2 TBI	3			51										54	5.4	
		Type 3 TBI	2													2	0.2	
	Other Head, Face, Neck	Other head					4					0	0	9		13	1.3	10.3
		Face	38	0	1		13					2				54	5.4	
		Eye					3			9		3	0			15	1.5	
		Neck	0		0		1				0	0	0			1	0.1	
		Head, Face, Neck Unspec.							1	7	1	7	0	3		19	1.9	
Spine and Back	Spinal Cord (SCI)	Cervical SCI	0			1										1	0.1	0.2
		Thoracic/Dorsal SCI	0			0										0	0.0	
		Lumbar SCI	1			0										1	0.1	
		Sacrum Coccyx SCI	0			0										0	0.0	
		Spine, Back Unspec. SCI	0			0										0	0.0	
	Vertebral Column (VCI)	Cervical VCI	3	0	2											5	0.5	2.5
		Thoracic/Dorsal VCI	4	0	1											5	0.5	
		Lumbar VCI	8	0	4											12	1.2	
		Sacrum Coccyx VCI	1	0	0											1	0.1	
		Spine, Back Unspec. VC	2	0												2	0.2	
Torso	Torso	Chest (thorax)	3	0	0	7	1		1	4	0	1	0			17	1.7	4.6
		Abdomen				7	2		0	2		0	0			11	1.1	
		Pelvis, Urogenital	4	0	2	0	2		0	1	0	0	0			9	0.9	
		Trunk	0				0			2	0	0	0	3		5	0.5	
		Back, Buttock			3		0			0	0	1				4	0.4	
Extremities	Upper	Shoulder, Upper Arm	16	7	3		3	0		3	0	0		2		34	3.4	28.0
		Forearm, Elbow	26	2	0		7	0		1	1	4				41	4.1	
		Wrist, Hand, Fingers	84	5	5		44	20		3	18	11		1		191	19.3	
		Other & Unspec.	0				1	0	3	4	0	0	4	0		12	1.2	
	Lower	Hip	1	0	2					1	0					4	0.4	24.4
		Upper leg, Thigh	7					0		0	3	1				11	1.1	
		Knee	4	33	1					0	0	0				38	3.8	
		Lower leg, Ankle	85	2	8			0		5	1	2				103	10.4	
		Foot, toes	24	0	0		3	1		8	4	0				40	4.0	
		Other & Unspec.	0		8		28	0	0	6	0	0		4		46	4.6	
Unclass. by Site	Other, Unspecified	Other/Multiple	0						0			0	0			0	0.0	1.4
		Unspec. Site	0	0	5	0	0		0	0	0	2	1	6		14	1.4	
	System-wide & late effects														209	209	21.1	21.1
		Total	324	49	45	76	112	21	5	56	28	34	5	28	209	992		
		Percent	32.7	4.9	4.5	7.7	11.3	2.1	0.5	5.6	2.8	3.4	0.5	2.8	21.1		100.0	100.0

Note:
ICD-9-CM 800-995 CODES. Includes only injuries resulting in in-CENTCOM hospitalization.

Tables 5. Notes:

- Table 5 uses the Barell injury matrix to categorize traumatic NBIs that required in-theater hospitalization by nature of injury and body region.

- In 2008, there were 992 NBIs that required in-theater hospitalization (coded in the 800-995 ICD-9-CM code series).

- The most common types of injury leading to in-theater hospitalization were fractures (33 percent), open wounds (11 percent), and internal injuries (8 percent).

- Injured body regions most commonly leading to in-theater hospitalization were upper extremities (28 percent); lower extremities (24 percent); and head, face, and neck injuries (18 percent).

- Leading specific reasons for in-theater hospitalization included fractures of the lower leg and/or ankle (9 percent); fracture of the wrist, hand, and/or fingers (8 percent); and internal head injuries (5 percent).

Table 6. Frequency of Hospitalized NBI-Related Musculoskeletal Conditions by Location and Nature of Injury, U.S. Army, OIF/OEF, CY 2008

			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	Percent	Percent by Body Region
Spine and Back	Vertebral Column (VCI)	Cervical VCI	5	1	2				8	5.4	55.1
		Thoracic/Dorsal VCI		0	7				7	4.8	
		Lumbar VCI	35	9	2				46	31.3	
		Sacrum Coccyx VCI	0						0	0.0	
		Spine, Back Unspec. VCI	19	0	0	1			20	13.6	
Extremities	Upper	Shoulder	7	1			0	2	10	6.8	12.2
		Upper Arm, Elbow	6	0		0		0	6	4.1	
		Forearm, Wrist	1	0		0		0	1	0.7	
		Hand	1	0			0	0	1	0.7	
	Lower	Pelvis, Hip, Thigh	0	0		0	0	0	0	0.0	28.6
		Lower leg, Knee	23	15		0	4	0	42	28.6	
		Ankle, Foot	0	0			0	0	0	0.0	
Unclass. by Site	Other, Unspecified	Other specified/Multiple	0	0		0	0	0	0	0.0	4.1
		Unspecified Site	5	0	1	0	0	0	6	4.1	
		Total	102	26	12	1	4	2	147		
		Percent	69.4	17.7	8.2	0.7	2.7	1.4		100.0	100.0

Note:
ICD-9-CM 710-739 CODES. Includes only injuries resulting in in-CENTCOM hospitalization.

Table 6. Notes:

- Table 6 categorizes NBI-related musculoskeletal conditions (a subset of musculoskeletal conditions coded in the 719-739 ICD-9-CM series) that required in-theater hospitalization by nature of injury and body region affected.

- In 2008, 147 NBI-related musculoskeletal conditions required in-theater hospitalization.

- The leading specific injury-related musculoskeletal conditions were inflammation and pain (overuse) involving the lumbar spine (24 percent), inflammation and pain (overuse) to the lower leg and/or knee (16 percent), and inflammation and pain (overuse) involving the spine, unspecified location (13 percent).

Table 6. Notes (continued):

- The most common types of musculoskeletal conditions leading to in-theater hospitalization were inflammation and pain (overuse) (69 percent), joint derangement (18 percent), and joint derangement with neurological (8 percent).

- The spine/back (55 percent) was the body region most affected by injury-related musculoskeletal conditions, followed by lower extremities (29 percent), and upper extremities (12 percent).

d. Discussion.

(1) For CY 2008, NBI was the largest single diagnosis category that resulted in out-of-CENTCOM air evacuation. The NBI was second to digestive diseases for OIF hospitalizations and second to battle injuries for OEF hospitalizations. Our present findings are consistent with previous studies showing the magnitude of the relative importance of NBIs.[2-4,10] In this report for OIF and OEF in CY 2008, there were 6 times more disease and NBIs than battle injuries and 36 percent were evacuated for NBIs or injury-related musculoskeletal conditions. A previous description of medical air evacuations from OIF by Harman showed 6 times more DNBIs than battle injuries, and 41 percent of all cases were evacuated for injuries or injury-related musculoskeletal conditions.[2] Sanders et al. reported that 35 percent of surveyed military personnel deployed to OIF/OEF during 2003-2004 self-reported having experienced an NBI.[4] According to Wojcik et al., NBI was the leading diagnosis group within DNBI for hospital admissions of OEF and OIF Soldiers from operation start dates through December 2004.[3] In this report for CY 2008, the digestive disease diagnosis category is similar to or slightly greater than NBI.

(2) The annual NBI air-evacuation rates for OIF decreased over time from a high in 2003. Similarly the annual hospitalization rates for OIF gradually decreased over time from a high in 2003. The annual NBI death rate for OIF has remained constant. OEF has had greater fluctuation in rates of air evacuation and hospitalization than OIF with 2004 and 2007 being peak years. The decrease in NBI rates in this report from a high in 2003 agrees with these previous studies. Injury rates and trends for OIF and OEF were previously reported or suggested by other descriptive studies.[11] During OIF-1 (21Mar-30Apr 2003) and OIF-2 (1Mar 2004–30Apr 2005), the majority of hospitalizations were DNBI (75.0 percent).[12] The DNBI hospitalization admission rates for OIF and OEF Soldiers from operation start dates through 2004 (0.14 and 0.14 per 1,000 Soldier-days, respectively) were lower than those of Operations Desert Shield and Storm (0.24 per 1,000 Soldier-days).[3] For OIF over time, there was an initial increase in admissions from the build-up (0.14 per 1,000 Soldier-days) to ground combat phase (0.18 per 1,000 Soldier-days), after which the admission rate stabilized (0.14 per 1,000 Soldier-days).

(3) In this report, the leading NBI types for 2008 were fracture, inflammation and pain (overuse), dislocation, and sprain/strain. The back was most commonly involved (17-18 percent), followed by the knee, wrist/hand, ankle/foot, and shoulder. In general, previous studies have focused on specific body regions or diagnosis categories when describing injury or disease type. According to Enad and Headrick, one treatment facility reported treating three times as many nonbattle orthopedic injuries as battle orthopedic injuries during the combat phase of OIF (March to May 2003).[13] In

reference to this previous study, our findings of fractures and dislocations as leading NBI types extends the available information regarding orthopedic injuries.

(4) Head injuries are an area of interest for the present conflicts in Iraq and Afghanistan. Forty-one percent of Soldiers being evaluated for recurrent headaches following a tour in Iraq reported head or neck trauma while deployed.[14] The majority of these injuries were attributed to exposure to blast. Of over 2,500 Soldiers surveyed upon returning from Iraq in 2006, 15 percent reported injuries with either loss of consciousness or altered mental state. Of these Soldiers reporting mild TBI, 33 percent also met criteria for Post-Traumatic Stress Disorder (PTSD).[15] In this report for 2008, only NBIs are included in the frequencies of air evacuations by body region. Seven percent of NBI air evacuations involve injury to the head and neck, 4 percent of these being traumatic brain injuries.

(5) The U.S. Army uses surveillance data to identify cause of injury and potentially modifiable risk factors for injury to develop comprehensive injury prevention programs. This report identified the top three causes of NBI air evacuations in 2008 as sports/physical training, falls/jumps, and crush/blunt trauma injuries. Leading causes of NBI hospitalizations differed, with the top three being toxic substances, land transport-related accidents, and falls/jumps. The leading causes of fatalities are own weapon (gunshot wounds), land transport-related accidents, and air transport accidents. Overall, self-inflicted injuries are becoming a significant cause of in-theater hospitalizations in OIF and OEF (positive trend for rate, $p<.01$; data not shown). Sports/physical training and falls/jumps continue to be leading causes of NBIs, although the rates of these injuries have been decreasing over time.

(6) This 2008 report is an update of the 2007 report.[5] The impact of injuries and causes, nature, and body region of injuries are similar from 2007 to 2008. However, the rate of OIF and OEF combined NBIs decreased from 2007 to 2008 for air evacuations, hospitalizations, and deaths (all $p<.001$).

(7) Current intervention studies and strategies (civilian and military) to address deployment NBI include:

(a) Use of ankle braces (stabilizers) to reduce ankle injuries.[16-18]

(b) Ocular preventive measures such as hygiene, contact lens restriction, and protective eyewear use during participation in racquet and contact sports.[19-22]

(c) Rollover drowning prevention training, rollover simulator training, equipment modifications to prevent rollover accidents, and improved compliance for seatbelt use.[23-25]

(d) Breakaway bases, recessed bases, and proper sliding technique education for softball sliding injuries.[26]

(e) Mouthguard use in sport activities where there is significant risk of orofacial injury.[27]

e. Conclusions. Routinely collected air evacuation, inpatient hospitalization, and casualty data provided the basis for deployment injury surveillance during Army deployments in support of OIF and OEF during CY 2008. The proportion of NBIs is larger than BI and any other single category of disease and has a big impact on readiness. Like the 2007 report, the leading causes of these NBIs indicate that many are likely preventable. Timely reporting of injury rates, types, and causes, should allow commanders and Army leaders to focus attention on prevention strategies and policies while the operations are on-going.

f. Recommendations.

(1) Continue routine surveillance of deployment injuries and yearly updates of a deployment injury surveillance report.

(2) Link additional data sources, such as level IV and V hospitalizations, and disability records to provide an enhanced description of deployment injuries and their outcomes.

(3) Conduct further research to identify modifiable risk factors that contribute to the leading causes of injury.

(4) Devote additional study to sports/PT, falls/jumps, self-inflicted, and land transport injury prevention.

5. RESULTS OF ANALYTIC DEPLOYMENT INJURY SURVEILLANCE PROJECTS, CY 2008

a. Project Summaries.

(1) Impact of Military Deployment on Soldiers with Pre-Deployment Chronic and Recurrent Injuries, Operation Iraqi Freedom, 2003–2006.

(a) Soldiers with a prior injury are at increased risk for injury.[28-29] This investigation identified Soldiers air evacuated from OIF for worsening of a pre-deployment injury and describes the injury types, locations, and exacerbating causes for these chronic or recurrent (C-R) injuries.

(b) Records were reviewed for Soldiers air evacuated from OIF between March 19, 2003 and December 31, 2006. Patient history and diagnosis fields were used to identify C-R injuries, classify injury type, location, and exacerbating cause.

(c) Of 9530 Soldiers evacuated for NBIs, 1509 (15.8 percent) had a C-R injury. Leading injury types were inflammation/pain from overuse (35 percent) and dislocations (15 percent). The primary location was back (33 percent), followed by knee (19 percent), and shoulder (15 percent). When the exacerbating cause was specified, 20 percent of cases identified wearing boots and/or interceptor body armor as the cause. See Figure 11 for a complete distribution of causes.

(d) C-R injuries accounted for 16 percent of NBI evacuations, and require further investigation to diminish their effect on deployed Soldiers.

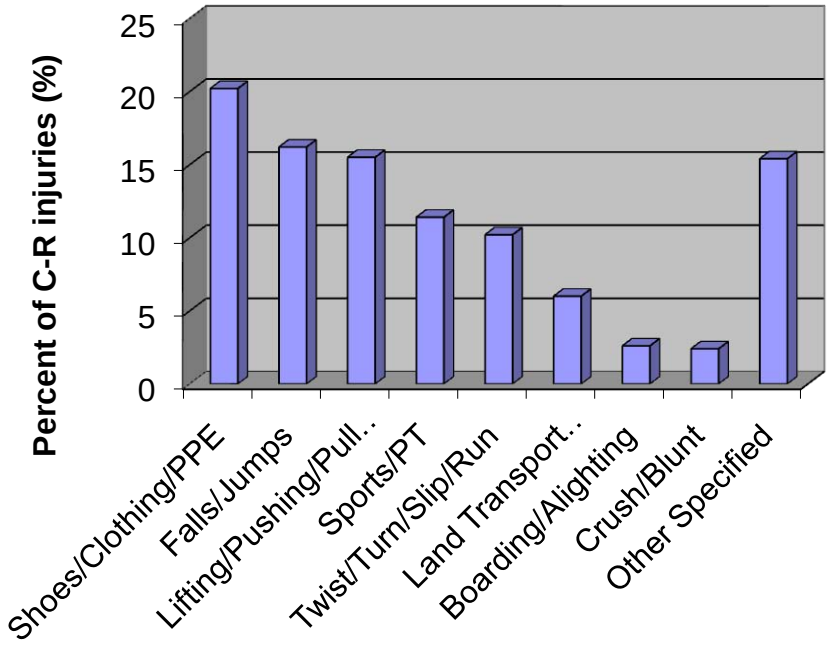


Figure 11. Cause of Injury Distribution for Exacerbation of Pre-Deployment Chronic or Recurrent Injuries for OIF, 2003-2006 (N=420)

(2) Army Soldier Vehicle-related NBIs Air Evacuated from OEF and OIF, 2001-2006.

(a) Falls/jumps and motor vehicle crashes are among the leading causes of air evacuated NBIs for deployed Soldiers. Many falls and jumps are vehicle-related, as are numerous crush and machinery-associated injuries. This study describes injury cause distributions for land transport vehicle-related (LTVR) NBIs.

(b) All LTVR NBIs among OEF/OIF-deployed Soldiers air evacuated out of theater were captured from 2001-2006 medical air-evacuation data.

(c) Sixteen percent of all OIF/OEF air-evacuated NBIs were land vehicle-related. Overall, motor vehicle crashes accounted for 42 percent of the injuries. The high mobility multi-purpose wheeled vehicle (HMMWV) was the most frequently reported vehicle for motor vehicle crashes (28 percent). Additional leading causes included fall (14 percent) and riding in vehicles (9 percent). Trucks were the most frequently reported vehicle for falls, jumps, alighting, and loading/unloading. Fifty-seven percent of injuries involving trucks were caused by falls or jumps. Operation Iraqi Freedom had a

significantly greater percentage of jump injuries than OEF. Operation Enduring Freedom had a significantly greater percentage of pedestrian injuries than OIF. Figure 12 shows the distribution of LTVR injury causes.

(d) Motor vehicles pose a significant injury risk to Soldiers in various ways. For OEF and OIF deployed Soldiers, these risks include motor vehicle crashes, falls, riding, jumps, and crush injuries. Military vehicles have unique features (e.g., vehicle height, rotating turrets, and heavy hatches) that pose atypical injury risk. Many of these injuries are potentially preventable with hazard awareness and considerable caution. Preventing other land vehicle-related NBIs (e.g., thrown within vehicle due to rough terrain) may require more innovative intervention.

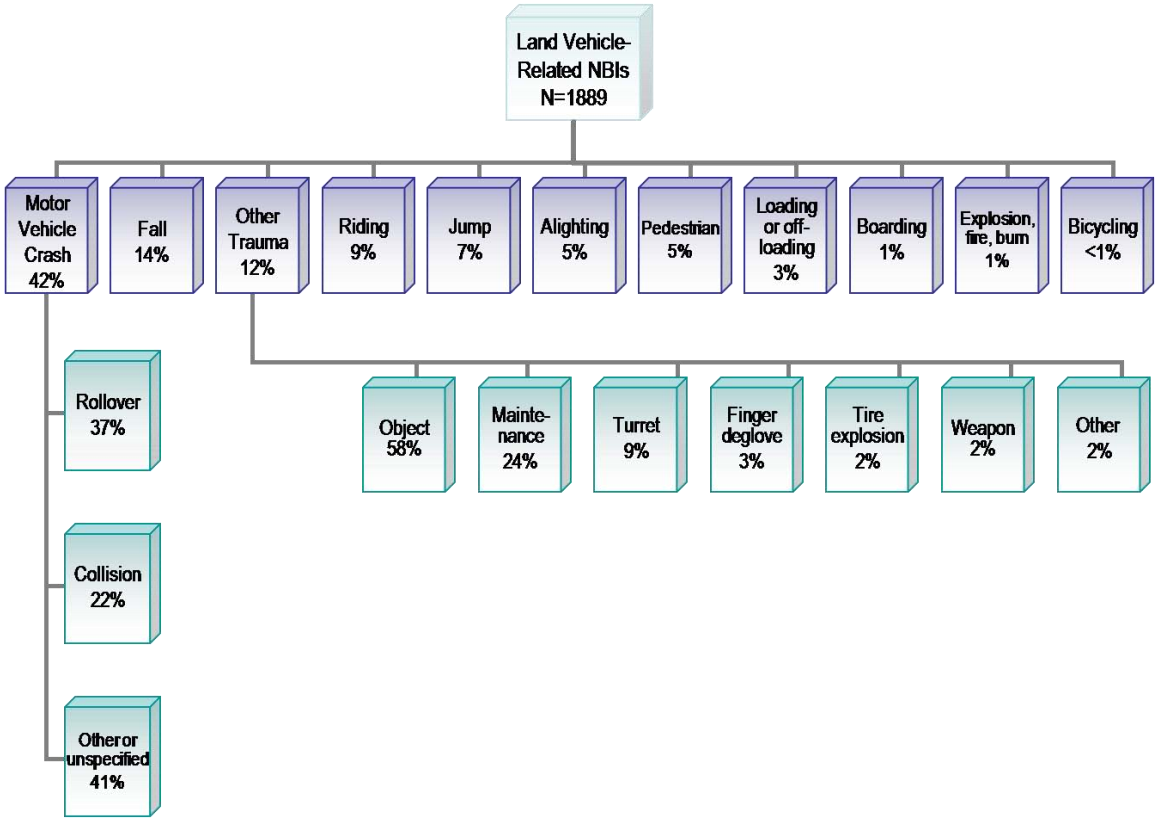


Figure 12. LTVR NBIs: OEF/OIF, 2001-2006

(3) Relative Impact of Injuries among Soldiers Hospitalized In-Theater While Deployed for Operation Iraqi Freedom, 2003-2007.

(a) Previous reports identified injuries as a major cause of hospitalization during military deployments. This retrospective evaluation describes the hospitalization rate, casualty type, diagnosis categories, and injury causes for in-theater hospitalizations for Soldiers deployed to OIF.

(b) From March 2003 through December 2007, 26,589 Soldiers were hospitalized in theater while deployed for OIF (annual rate: 40/1000 Soldiers). See Figure 13 for quarterly rates by casualty type (that is, battle injury, NBI, and illness). Soldiers' mean age was 28 years and 89 percent were male. Fifty-five percent of hospitalizations were for disease, 25 percent for BIs, and 19 percent for NBIs. The leading diagnosis categories were injury (44 percent), digestive (13 percent), ill-defined signs/symptoms (10 percent), and genitourinary (7 percent). Enemy instruments of war (97 percent) were the leading cause of BIs, while motor vehicle accidents (23 percent), falls (12 percent), ingestion of toxic substances (11 percent), and heat/cold injuries (10 percent) were leading causes of NBIs.

(c) This study clearly demonstrates the relative importance of injury hospitalizations among deployed OIF Soldiers and identifies leading NBI causes for targeted prevention strategies.

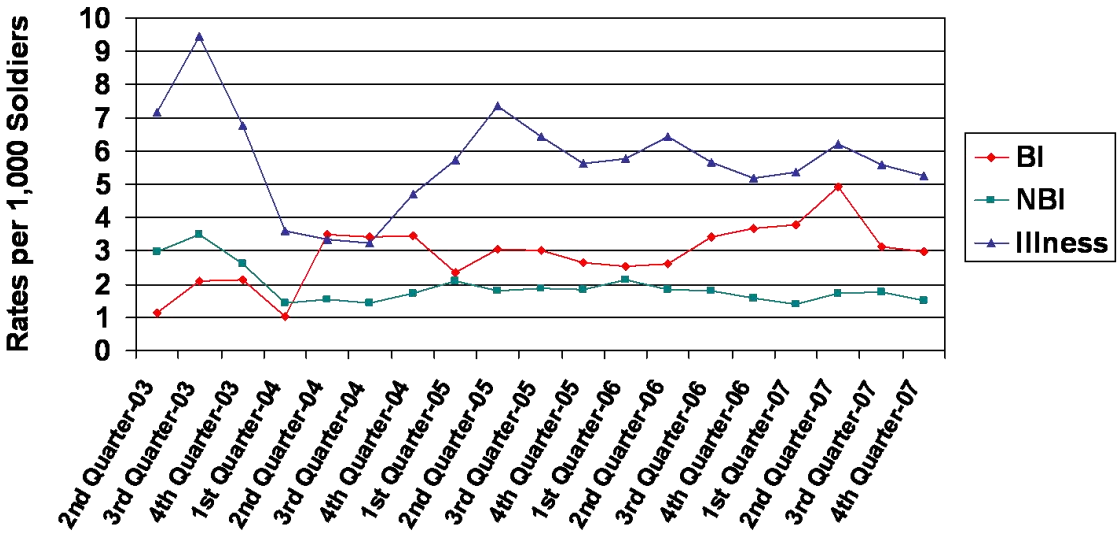


Figure 13. Quarterly in Theater Admission Rates by Casualty Type for OIF, 2003-2007

(4) Causes of NBI Fatalities among U.S. Army Soldiers during OEF and OIF, October 2001–December 2006.

(a) As with previous military conflicts, NBIs are a major cause of mortality in OEF and OIF. The purpose of this retrospective analysis was to" (1) describe the incidence and rate of fatal NBIs in OEF and OIF from their beginning through December 2006, (2) describe the causes and circumstances of fatal NBIs, and (3) compare two Army-data systems that report fatal NBI incidents.

(b) This analysis included all U.S. Army Soldiers who died from NBI while deployed for OEF (October 2001–December 2006) or OIF (March 2003–December 2006). An NBI-fatality case was defined as any Soldier (Regular Army, Army Reserve, or Army National Guard) who died due to a NBI sustained while in a deployed status for OEF or OIF, including while on mid-tour leave. This investigation included NBI fatalities resulting from: (1) unintentional injury incidents, (2) intentional incidents (e.g., homicides, suicides), and (3) physical training.

Table 7. Distribution of Causes of Fatal NBI for OEF and OIF, from the Start of Conflict through December 2006

Causes	Overall (n=492)		OEF (n=98)		OIF (n=394)	
	n	%	n	%	n	%
LTVR Accidents	199	40.4	16	16.3	183	46.4
Self-Inflicted Injuries	90	18.3	12	12.2	78	19.8
Air Transport Accidents	90	18.3	51	52.0	39	9.9
Handling Weapons and Explosives	49	10.0	13	13.3	36	9.1
Sports and Physical Training	11	2.2	1	1.0	10	2.5
Machinery and Tools	11	2.2	1	1.0	10	2.5
Environmental Factors	10	2.0	1	1.0	9	2.3
Falls/Jumps	8	1.6	1	1.0	7	1.8
Homicide	6	1.2	0	0.0	6	1.5
Ingestion/Inhalation of Toxic Substances	4	0.8	1	1.0	3	0.8
Fire	4	0.8	0	0.0	4	1.0
Others	10	2.0	1	1.0	9	2.3

(c) The NBIs were responsible for 21 percent of all deaths in OEF and OIF. As shown in Table 7, the leading causes of fatal injury were LTVR accidents (41 percent), self-inflicted wounds (18 percent), and air transport–related accidents (18 percent).

(d) Measures have been taken to lower the rate of NBI fatalities during these deployments. More prevention strategies must be researched, implemented, and continually taught to Soldiers in theater to reduce these potentially avoidable deaths.

(5) Casualties among Explosive Ordnance Disposal Soldiers Deployed in Support of Operations Enduring Freedom and Iraqi Freedom, October 2001–December 2007.

(a) The U.S. Army 20th Support Command (CBRNE), Aberdeen Proving Ground, MD, requested this evaluation of deployed explosive ordnance disposal (EOD) Soldiers. The EOD Soldiers may be exposed to greater injury risks than other deployed Soldiers due to their unique mission requirements.

(b) Data used in this evaluation included Army casualty data, medical air evacuations, hospitalizations, and deployment data for all EOD Soldiers deployed for OEF and OIF, October 2001-December 2007. Casualty and deployment data for all deployed Army Soldiers were used for comparison with EOD Soldiers.

(c) Overall, 210 casualties were identified (OEF: n=46; OIF: n=164). Of these, 109 were hostile injuries (52 percent), 39 (19 percent) were nonhostile injuries, and 62 (30 percent) were illnesses or other medical conditions. There were 21 fatalities (OEF: n=3; OIF: n=18): 18 fatal hostile injuries, 2 fatal nonhostile injuries, and 1 illness-related fatality. All 18 fatal hostile injuries, 84 (95 percent) nonfatal hostile injuries, and 3 nonhostile injuries (1 fatal and 2 non-fatal) were caused by detonation of explosive devices (see Table 8). The EOD hostile injury rate for OIF (50.4 injuries/1000 deployed person-years) was 1.5 times higher than the OEF rate (34.1 injuries/1000 deployed person-years). The EOD fatal hostile injury rates for OEF and OIF were 2.7 and 2.4 times higher, respectively, than the deployed Army rates. The EOD nonfatal hostile injury rates for OEF and OIF were 1.6 and 1.3 times higher, respectively, than the deployed Army rates.

(d) Though EOD Soldiers have higher fatal and nonfatal hostile injury rates compared with the Army as a whole, it cannot be concluded that EOD Soldiers have a higher hostile injury rate than other potentially high risk MOSs such as infantry, armor, and transportation.

Table 8. Casualty Causes among EOD Soldiers Deployed for OEF and OIF, 2001–2007

Casualty Type	Cause	Frequency (n)
Hostile Injuries[1]		
Fatal (n=18)	detonation of explosive device	18
Nonfatal (n=91)	detonation of explosive device	83
	sprained ankle running to avoid a detonation blast	1
	small arms fire	7
Nonhostile Injuries[1]		
Fatal (n=2)	detonation of explosive device	1
	self-inflicted	1
Nonfatal (n=37)	detonation of explosive device	2
	sports	6
	falls and near-falls	6
	lifting	4
	crushing from falling/dropped objects	3
	motor vehicle accident	1
	use of hand tools (mechanic)	1
	other and unknown	14
Fatal Illness (medical) (n=1)	cardiac arrest after physical training	1

Note:
[1] Hostile vs. nonhostile was determined from the DCIPS.

(6) Pre-existing and chronic injuries of U.S. Soldiers requiring air evacuation from deployments during CY 2003.

(a) The purpose of this analysis was: (1) to describe the feasibility of using TRAC^{2}ES to identify U.S. Soldiers deployed for OIF/OEF with pre-existing injuries (PEIs) and chronic musculoskeletal conditions and (2) to determine the prevalence and types of PEI and chronic musculoskeletal conditions that required air evacuation from OIF/OEF.

(b) Of the 10,068 air medical evacuations from OIF/OEF during CY 2003, 3,651 (36 percent) were for NBIs. The PEI and chronic musculoskeletal conditions accounted for 607 (17 percent) of the NBIs. The four leading types of PEI were herniated disc/ radiculopathy (22 percent), chronic pain (22 percent), meniscus tears (10 percent) and joint instability (8 percent). Lifting/pushing/pulling (19 percent), falls (18 percent), sports/PT (13 percent), twisting/turning/slipping/running (13 percent), and wearing of shoes/clothes (11 percent) were the five leading injury causes for Soldiers air evacuated

from theater with a PEI. The leading MOSs for Soldiers air evacuated for a PEI or chronic musculoskeletal condition are shown in Table 9.

(c) Since these Soldiers required air evacuation from OIF and OEF while deployed, these PEIs had a direct negative effect on the Soldiers' units' readiness. These personnel losses during deployment represent a major cost to the Army, in both financial and manpower terms.

Table 9. Top Five MOSs for Soldiers Medically Air Evacuated for a PEI or Chronic Musculoskeletal Condition Exacerbated During OIF/OEF, CY03

MOS	MOS Description	Frequency (n=607)	Percent (%)
88M	Motor Transport Operator	78	12.9
11B	Infantryman	42	6.9
95B	Military Police	36	5.9
92G	Food Service Operations	21	3.5
63B	Light Wheeled Mechanic	19	3.1
92A	Automated Logistical Specialist	19	3.1

*Source: DMDC, Jul 05 and TRAC^{2}ES

(7) Occupational and off-duty injuries among U.S. Army Soldiers deployed for Operation Iraqi Freedom, 2003–2006.

(a) Employment-related injuries negatively affect morale, motivation, and job performance in most occupational fields, including the military. For Army Soldiers deployed for combat operations, occupational and off-duty NBIs are especially critical if Soldiers are unable to perform their military duties and require medical evacuation to receive specialized treatment or rehabilitation. In these cases, unit combat readiness is negatively impacted. The objective of this investigation was to describe the incidence, types, anatomical locations, and causes of NBIs requiring medical evacuation of Army Soldiers from OIF.

(b) Air-evacuation records were reviewed for all Soldiers who sustained nonfatal NBIs requiring medical evacuation from Iraq between March 19, 2003 and December 31, 2006. Medical history and diagnosis were used to identify and classify the injury type, anatomical location, cause and intent for all nonfatal NBIs.

(c) Of 27,563 Soldiers medically evacuated from Iraq, 9,530 (35 percent) were for NBIs (NBI rate: 174/10,000 Soldiers). Leading injury types were fractures (19 percent), inflammatory pain syndromes (18 percent), dislocations (12 percent), and sprains/strains (11 percent) (see Figure 14). Leading anatomical locations were the back (18 percent), knee (15 percent), wrist/hand (13 percent), ankle/foot (11 percent), and shoulder (9 percent). Only 139 injuries were intentional (assaults or self-inflicted).

The top 3 unintentional injury causes were sports/exercise (19 percent), falls/jumps (18 percent), and motor vehicles-related accidents (15 percent).

(d) Over nine-thousand (9,530) Soldiers assigned to OIF sustained a serious nonfatal NBI requiring medical evacuation. These injuries negatively impact job performance and possibly Soldier retention, just as occupational injuries in other fields negatively affect job performance and employability.

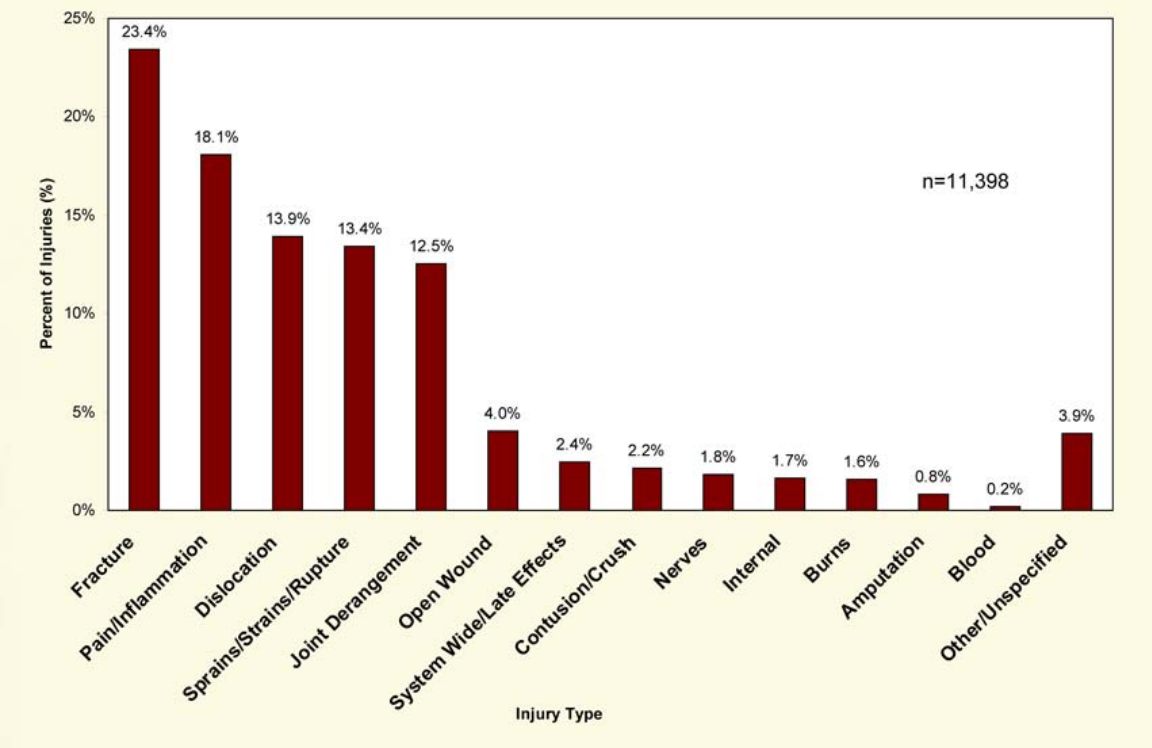


Figure 14. Diagnosis of Nonbattle Occupational and Off-Duty Injuries that Required Air Evacuation from OIF, 2003-2007

(8) Causes of Air Evacuated NBIs OIF/OEF, 2001-2006.

(a) The NBIs are a major cause of mortality and morbidity during combat operations. During the Persian Gulf War (1990-1991), NBIs accounted for 38 percent of hospitalizations.[30] Tasked by the Assistant Secretary of the Army (Installation and Environment) in 2004, U.S. Army Public Health Command (Provisional) (USAPHC (PROV), formerly the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) developed a deployment injury surveillance system to identify injury

causes. This presentation describes the relative impact of Army NBIs requiring medical air evacuation from OIF, and the leading NBI causes and types, 2003–2006.

(b) Overall, NBIs (35 percent) and BIs (18 percent) were the two leading diagnosis categories for air-evacuation casualties. The NBI rate was 17.4/1000. As shown in Table 10, leading NBI causes were sports/physical training (19 percent), falls/jumps (18 percent), motor vehicle-related (15 percent), and crushing/blunt trauma (9 percent). Most common injury types were fractures (19 percent), pain/inflammation (18 percent), and dislocations (12 percent). The OIF NBI types and causes are similar to those reported for the Persian Gulf War. Using air-evacuation records, we were able to identify causes of NBIs that required air evacuation from OIF and OEF.

Table 10. Causes of NBIs OIF/OEF (2001-2006)

Causes of Injury	OIF (2003-2006)[1]			OEF (2001-2006)[2]		
	Count (n)	(%)	Rank[3]	Count (n)	(%)	Rank[3]
Sports and physical training	1,163	18.5	1	195	20.5	1
Falls/Jumps	1,114	17.7	2	170	17.9	2
Motor vehicle accidents	1,020	16.2	3	109	11.5	3
Crushing or blunt trauma	533	8.5	4	85	8.9	4
Lifting, pushing, pulling	517	8.2	5	66	6.9	6
Twisting, turning, slipping	425	6.8	6	67	7.1	5
Boots, body armor	263	4.2	7	29	3.1	8
Cutting and piercing	194	3.1	8	17	1.8	10
Handling weapons and explosives	191	3	9	31	3.3	7
Environmental	171	2.7	10	24	2.5	9
Other specified	700	11.1		157	16.5	
Total	6,291	100		950	100	

Legend:
[1] Includes injuries for which the NBI cause was specified (66.1%), OIF: March 2003-December 2006.
[2] Includes injuries for which the NBI cause was specified (62.7%), OEF: October 2001-Dececmber 2006.
[3] Causes of injury are listed in descending order based on their distribution for OIF.

(c) Identifying NBI causes is a prerequisite for developing policy and actions to prevent deployment-related injuries.

b. Conclusions.

(1) Pre-deployment chronic and recurrent injuries and musculoskeletal conditions account for a significant portion of NBI air evacuations.

(2) Military vehicles have unique features (e.g., vehicle height, rotating turrets, and heavy hatches) that pose atypical injury risk. Many of these injuries are potentially preventable with hazard awareness and considerable caution.

(3) The relative importance of NBI fatalities, hospitalizations, and air evacuations among deployed OEF/OIF Soldiers has been clearly established. These injuries negatively impact job performance and possibly soldier retention. Some measures have already been taken to decrease the rate of NBIs during these deployments.

(4) The EOD Soldiers have higher fatal and nonfatal hostile injury rates compared with the Army as a whole; however, it cannot be concluded that EOD Soldiers have a higher hostile injury rate than other potentially high risk MOSs such as infantry, armor, and transportation.

c. Recommendations.

(1) Pre-deployment chronic and recurrent injuries and musculoskeletal conditions require further investigation to diminish their effect on deployed Soldiers.

(2) Explore innovative strategies to prevent land vehicle-related NBIs.

(3) Effective injury prevention strategies must be researched, implemented, and continually communicated to Soldiers in theater to reduce potentially avoidable fatal and nonfatal injuries.

(4) Continue to develop policy and practice to prevent deployment-related injuries.

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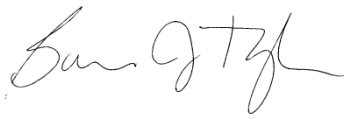

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APPENDIX A

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APPENDIX B
BARELL INJURY DIAGNOSIS MATRIX AND ASSOCIATED ICD-9-CM 800-995 CODES

				ICD-9-CM codes	FRACTURE 800-829	DISLOCATION 830-839	SPRAINS & STRAINS 840-848	INTERNAL 360-364,380-389 862, 996.66	OPEN WOUND 870-884, 890-894	AMPUTATIONS 885-887, 896-897	BLOOD VESSELS 900-904	CONTUSION / SUPERFICIAL 910-924	CRUSH 926-929	BURNS 940-948	NERVES 950-951 862-867	UNSPECIFIED 869
Head and Neck	Traumatic Brain Injury	1	Type 1 TBI	800,801,803,804(.1-.4,.6-.9), (.00-.05,.53-.55) 850(.2-.4), 851-854, 950(.1-.3), 995.55	800,801,803,804(.1-.4,.6-.9) 800,801,803,804(.00-.05,.53-.55)	/	/	850(.2-.4) 851-854*,995.55	/	/	/	/	/	/	950.1-.3	/
		2	Type 2 TBI	800,801,803,804(.00,.02,.05,.06) (.50,.52,.56,.59) ,850(.0,.1,.5,.9)	800,801,803,804(.00,.02,.06,.09), 800,801,803,804(.50,.52,.56,.59)			850(.0,.1,.5,.9)								
		3	Type 3 TBI	800,801,803,804(.01, .51)	800,801,803,804(.01,.51)	/	/	/	/	/	/	/	/	/	/	/
	Other Head, Face and Neck	4	Other Head	873(.0-.1,.8-.9),941.06,951,959.01	/	/	/	/	8730-.1,.8-.9	/	/	/	/	941.06	951	959.01*
		5	Face	802, 830, 848.0-.1, 872, 873.2-.7, 941(.01,.03-.05,.07)	802	830	8480-.1	/	872, 873.2-.7	/	/	/	/	941.01,.03-.05,.07	/	/
		6	Eye	8700-871, 918, 921, 940, 941.02, 950(.0,.5)	/	/	/	/	8700-871	/	/	918, 921	/	940, 941.02	950(.0,.5)	/
		7	Neck	807.5-.6, 848.2, 874, 925.2, 941.08, 953.0, 954.0	807.5-.6	/	848.2	/	874	/	/	/	925.2	941.08	953.0, 954.0	/
		8	Head, Face and Neck Unspecified	800, 910, 920, 925.1, 941.00, .09, 947.0, 957.0, 959.09	/	/	/	/	/	/	900	910, 920	925.1	941.00,.09, 947.0	957.0	959.09
Spine and Back	Spinal Cord (SCI)	9	Cervical SCI	806(.0-.1), 952.0	806.0-.1	/	/	952.0	/	/	/	/	/	/	/	/
		10	Thoracic/Dorsal SCI	806(.2-.3), 952.1	806.2-.3	/	/	952.1	/	/	/	/	/	/	/	/
		11	Lumbar SCI	806(.4-.5), 952.2	806.4-.5	/	/	952.2	/	/	/	/	/	/	/	/
		12	Sacrum/Coccyx SCI	806(.6-.7), 952(.3-.4)	806.6-.7	/	/	952.3-.4	/	/	/	/	/	/	/	/
		13	Spine* Back Unspecified SCI	806(.8-.9), 952(.8-.9)	806.8-.9	/	/	952.8-.9	/	/	/	/	/	/	/	/
	Vertebral Column (VC)	14	Cervical VC	805(.0-.1), 839(.0-.1), 847.0	805.0-.1	839.0-.1	847.0	/	/	/	/	/	/	/	/	/
		15	Thoracic/Dorsal VC	805(.2-.3), 839(.21,.31), 847.1	805.2-.3	839.21,.31	847.1	/	/	/	/	/	/	/	/	/
		16	Lumbar VC	805(.4-.5), 839(.20,.30), 847.2	805.4-.5	839.20,.30	847.2	/	/	/	/	/	/	/	/	/
		17	Sacrum/Coccyx VC	805(.6-.7), 839(.41-.42), 839(.51-.52), 847.3-.4	805.6-.7	839(.41-.42, .51-.52)	847.3-.4	/	/	/	/	/	/	/	/	/
		18	Spine* Back Unspecified VC	805(.8-.9), 839(.40,.49), 839(.50,.59)	805.8-.9	839(.40,.49,.50,.59)	/	/	/	/	/	/	/	/	/	/
Torso	Torso	19	Chest / Thorax	807.0-.4, 839(.61,.71), 848(.3-.4), 860-862, 875, 879(.0-.1), 901, 923(.0-.1,.3), 926.19, 942.01-.02 953.1	807.0-.4	839.61,.71	848.3-.4	860-862	875, 879.0-.1	/	901	923(.0,.1,.3)	926.19	942.01-.02	953.1	/
		20	Abdomen	863-866, 868, 879(.2-.5), 902(.0-.4), 922.2, 942.03, 947.3, 953(.2,.5)	/	/	/	863-866, 868	879.2-.5	/	902.0-.4	922.2	/	942.03, 947.3	953.2, 953.5	/
		21	Pelvis & Urogenital	808, 839(.69,.79), 846, 848.5, 867, 877-878 902(.5,.81-.82), 922.4, 926(.0,.12), 942.05,947.4, 953.3	808	839.69,.79	846, 848.5	867	877-878	/	902(.5, .81-.82)	922.4	926(.0,.12)	942.05, 947.4	953.3	/
		22	Trunk	809, 879(.6-.7), 911, 922(.8-.9), 926(.8-.9), 942(.00,.09), 954(.1,.8-.9), 959.1	809	/	/	/	879.6-.7	/	/	911, 922.8-.9	926.8-.9	942.00,942.09	954.1, .8-.9	959.1
		23	Back and Buttock	847.9, 876, 922(.31-.32), 926.11, 942.04	/	/	847.9	/	876	/	/	922.31-.32	926.11	942.04	/	/
Extremities	Upper	24	Shoulder & Upper arm	810-812, 831, 840, 880, 887(.2-.3), 912,923.0, 927.0, 943(.03-.06) ,959.2	810-812	831	840	/	880	887.2-.3	/	912, 9230	927.0	943.03-.06	/	959.2
		25	Forearm & elbow	813, 832, 841, 881(.00-.01), 887(.0-.1), 923.1, 927.1, 943(.01-.02)	813	832	841	/	881.00-.01	887.0-.1	/	923.1	927.1	943.01-.02	/	/
		26	Wrist, hand & fingers	814-817, 833-834, 842, 881.02, 882, 883, 885-886, 914-915, 923(.2-.3), 927(.2-.3), 944, 959(.4-.5)	814-817	833, 834	842 /	/ /	881.02,882, 883	885-886	/ /	914-915, 923.2-.3	927.2-.3	944 /	/ /	959.4-.5
		27	Other & unspecified	818, 834, 887(.4-.7), 903, 913, 923(.8-.9), 927(.8-.9), 943(.00,.09), 953.4, 955, 959.3	818	/	/	/	884	887.4-.7	903	913,923.8,.9	927.8-.9	943.00,.09	953.4, 955	959.3
	Lower	28	Hip	820, 835, 843, 924.01, 928.01	820	835	843	/	/	/	/	924.01	928.01	/	/	/
		29	Upper leg & thigh	821, 897(.2-.3), 924.00, 928.00, 945.06	821			/	/	897.2-.3	/	924.00	928.00	945.06	/	/
		30	Knee	822, 836, 844.0-.3, 924.11, 928.11, 945.05	822	836	844.0-.3	/	/	/	/	924.11	928.11	945.05	/	/
		31	Lower leg & ankle	823-824, 837, 845.0, 897(.0-.1), 924(.10,.21), 928(.10,.21), 945(.03-.04)	823-824	837	845.0	/		897.0-.1	/	924.10,.21	928.10,.21	945.03-.04	/	/
		32	Foot & toes	825-826, 838, 845.1, 892-893, 895-896, 917, 924(.3,.20), 928(.3,.20), 945(.01-.02)	825-826	838	845.1	/	892-893	896-896	/	917, 924.3,.20	928.3,.20	945.01-.02	/	/
		33	Other & unspecified	827, 844(.8-.9), 880-891, 894, 897(.4-.7), 904(.0-.8), 916, 924(.4-.5), 928(.8-.9), 945(.00,.09), 959.6-.7	827	/	844.8,.9	/	890-891,894	897.4-.7	904.0-.8	916, 924.4-.5	928.8,.9	945.00-.09	/	959.6-.7
Unclassifiable by Site	Other & unspecified	34	Other multiple	819, 828, 902, 87, .89), 947(.1-.2), 953.8, 956	819, 828	/	/	/	/	/	902.87, .89	/	/	947.1-.2	953.8, 956	/
		35	Unspecified site	829, 839(.8-.9), 848(.8-.9), 869, 879(.8,.9), 902.9, 904.9, 919, 924(.8,.9), 928(.8,.9), 946, 947.8,.9, 948, 949, 9539, 957(.1,.8,.9), 959(.8,.9)	829	839.8-.9	848.8-.9	869	879(.8-.9)	/	902.9, 904.9	919, 924.8,.9	929	946, 947.8,.9 948, 949	953.9, 957.1,.8,.9	959.8,.9
	Systemic/Visceral	36	System-wide & Internal	905-908, 909(.0,.1,.2,.4,.5), 930-939,958, 960-994, 995.50-.54,.59, 995(.80-.85)	Foreign body (930-939), Early complications of trauma (958), Poisoning (960-979), Toxic Effects (980-989), Other and unspecified effects of external cause (990-994) Child and adult maltreatment (995.50-.54,.59, 995.80-.85) Late effects of injuries, poisonings, toxic effects and other external causes (905-909) excluding 909(.3, .5)											

APPENDIX C
INJURY-RELATED MUSCULOSKELETAL CONDITION MATRIX AND ASSOCIATED ICD-9-CM 710-739 CODES

Injury Location			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological Involvement	Stress Fracture	Sprains/Strains/ Rupture	Dislocation
	Vertebral Column	Cervical	723.1	722.0	722.71, 723.4			
		Thoracic/Dorsal		722.11	722.72, 724.4			
		Lumbar	724.2	722.10	722.73, 724.3			
		Sacrum, Coccyx	720.2					
		Spine, Back Unspecified	721.7, 724.5	722.2	722.70, 724.9	733.13		
Extremities	Upper	Shoulder	716.11, 719(.01,.11,.41), 726(.0,.1,.2)	718(.01,.11,.81,.91)			727(.61-.62)	718.31
		Upper arm, Elbow	716.12, 719(.02,.12,.42), 726.3	718(.02,.12,.82,.92)		733.11		718.32
		Forearm, Wrist	716.13, 719(.03,.13,.43), 726.4	718(.03,.13,.83,.93)		733.12		718.33
		Hand	716.14, 719(.04,.14,.44)	718(.04,.14,.84,.94)			727(.63-.64)	718.34
	Lower	Pelvis, Hip, Thigh	716.15, 719 (.05,.15,.45), 726.5	718(.05,.15,.85,.95)		733(.14-.15)	727.65	718.35
		Knee, Lower leg	716.16, 717.7, 719(.06,.16,.46), 726.6	717(.0-.6,.9), 718(.06,.16,.86,.96)		733(.16,.93-.94)	717.8, 727(.66-.67)	718.36
		Ankle, Foot	716.17, 719(.07,.17,.47), 726.7, 728.71, 734	718(.07,.17,.87,.97)			727.68	718.37
Unclassified by Site	Others and Unspecified	Other specified/Multiple	716(.18-.19), 719(.08-.09,.18-.19,.48-.49), 726.8, 727.2	718(.08,.09,.18,.19,.88,.89,.98,.99)		733.19	727.69	718(.38,.39)
		Unspecified Site	716.10, 719(.00,.10,.40), 726.9, 727.3, 729.1	718(.00,.10,.80,.90)	729.2	733(.10,.95)	727.60, 728.83	718.30